Protocol for analysis of stereo Diver-Operated Videos (stereo-DOVS)

Sharks Project – Charles Darwin Research Station

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Revisions:

Version 2, 2019 - Denisse Fierro Arcos

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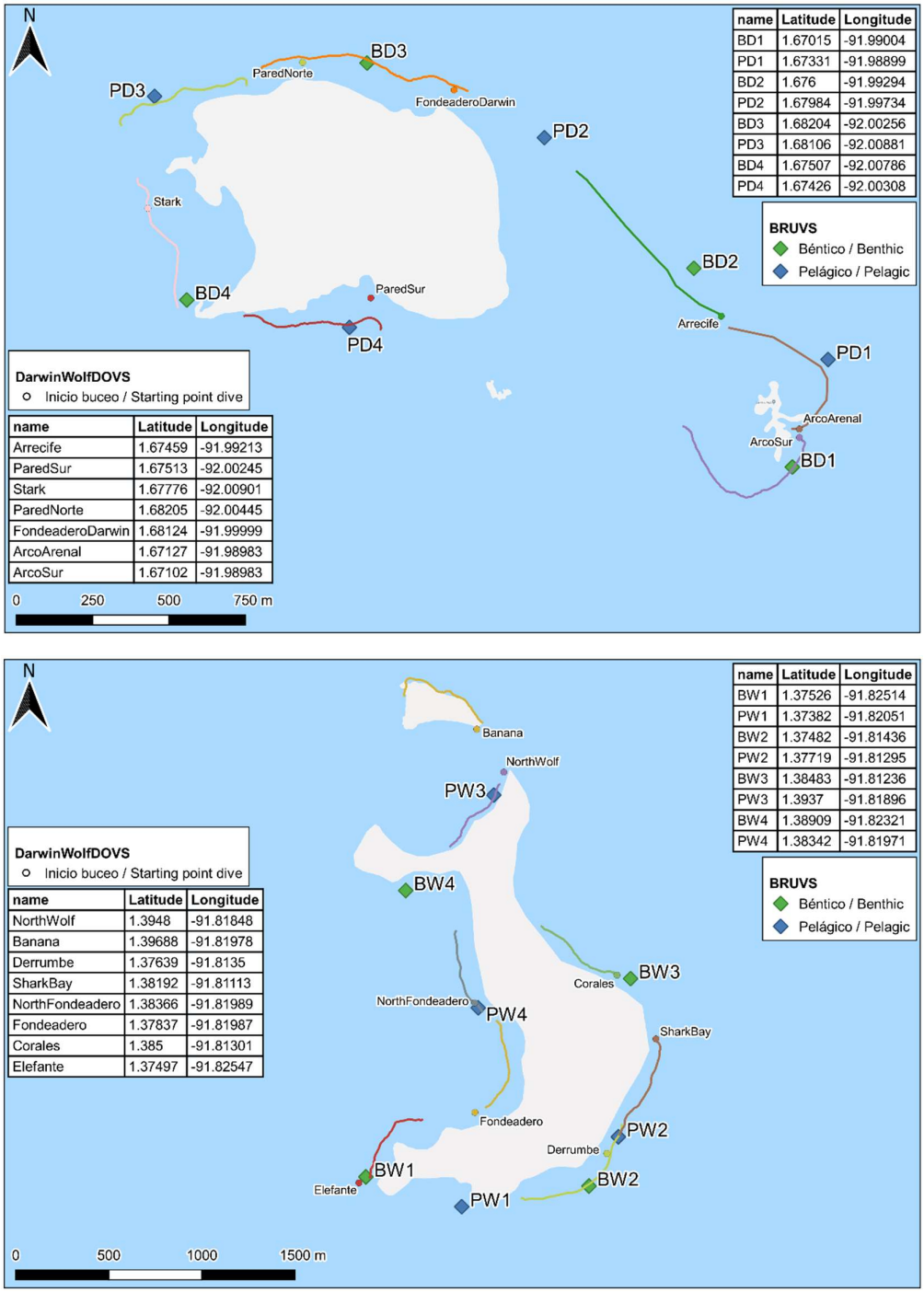
1 Introductory points for stereo-DOVs analysis

- Our ongoing stereo-DOV campaign at Darwin and Wolf islands cover a total of 15 sites across these two islands: 7 sites at Darwin and 8 sites at Wolf island. Figure 1 shows the location, site names and coordinates for the starting point for each dive.



name	Latitude	Longitude
BD1	1.67015	-91.99004
PD1	1.67331	-91.98899
BD2	1.676	-91.99294
PD2	1.67984	-91.99734
BD3	1.68204	-92.00256
PD3	1.68106	-92.00881
BD4	1.67507	-92.00786
PD4	1.67426	-92.00308

BRUVS
Béntico / Benthic
Pelágico / Pelagic

DarwinWolfDOVS
Inicio buceo / Starting point dive

name	Latitude	Longitude
Arrecife	1.67459	-91.99213
ParedSur	1.67513	-92.00245
Stark	1.67776	-92.00901
ParedNorte	1.68205	-92.00445
FondeaderoDarwin	1.68124	-91.99999
ArcoArenal	1.67127	-91.98983
ArcoSur	1.67102	-91.98983

name	Latitude	Longitude
BW1	1.37526	-91.82514
PW1	1.37382	-91.82051
BW2	1.37482	-91.81436
PW2	1.37719	-91.81295
BW3	1.38483	-91.81236
PW3	1.3937	-91.81896
BW4	1.38909	-91.82321
PW4	1.38342	-91.81971

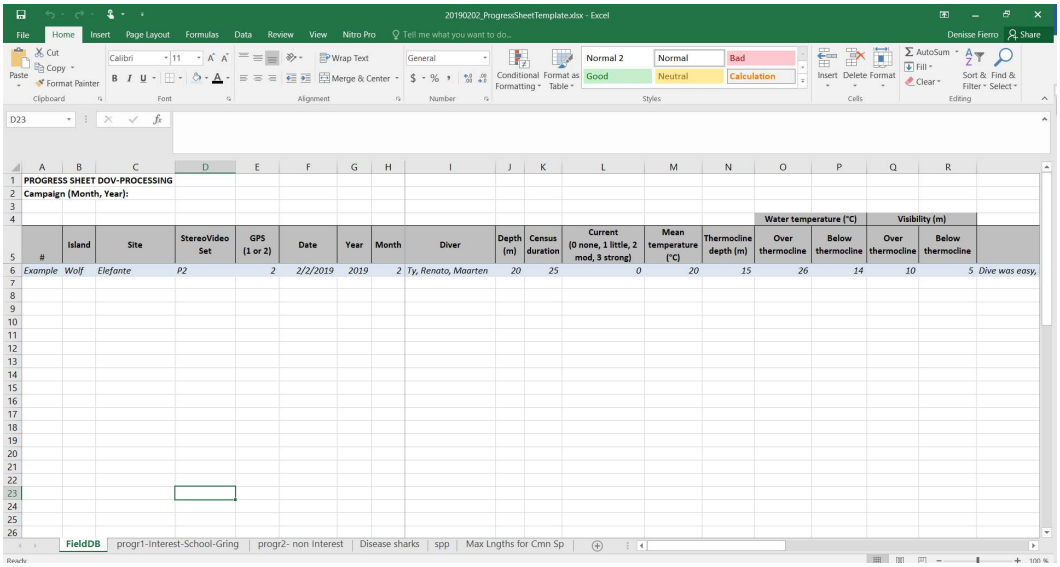
BRUVS
Béntico / Benthic
Pelágico / Pelagic

DarwinWolfDOVS
Inicio buceo / Starting point dive

name	Latitude	Longitude
NorthWolf	1.3948	-91.81848
Banana	1.39688	-91.81978
Derrumbe	1.37639	-91.8135
SharkBay	1.38192	-91.81113
NorthFondeadero	1.38366	-91.81989
Fondeadero	1.37837	-91.81987
Corales	1.385	-91.81301
Elefante	1.37497	-91.82547

Figure 1 – Location of stereo-BRUVs deployments (diamonds) and stereo-DOVs transects (lines) at Darwin (top) and Wolf (bottom) islands. Coordinates given in decimal degrees (CRS: WGS84).

- Before training is started, every analyst must have a Google Drive account. Working spreadsheets will be shared through this platform to ensure all parties analysing the same stereo-DOVs campaign have access to the same document. This will prevent the creation of multiple versions of the same document.
- Ensure camera systems have been calibrated prior to the video analysis (See Section 4 - Calibration of camera systems for more information). If cameras were changed in a stereo-DOV system, it will be necessary to recalibrate the system before any videos can be analysed.
- Video analysts must be thoroughly trained by a senior team member in the correct use of EventMeasure and/or fish identification. After the initial training period, the new video analyst will have two (2) weeks to examine a 'testing video' on their own. This 'testing video' is any video that has been previously analysed and checked for accuracy by a senior member of our team. To be deemed competent, analysts must obtain a minimum of 90% accuracy in the identification of species present in the 'testing video'.
- After training is completed, it is expected the analysis will take between 3-4 days per video.
- For stereo-DOVs, fish are divided into **four (4) categories**, each is treated slightly differently during the analysis phase. This will be explained with more detail under Section 5 - Analysing stereo-DOV.
    - Spp of interest - large carnivorous species
    - Spp of NO interest - small herbivorous species
    - Schools - aggregations of more than 20 individuals of the same species
    - Gringos (*Paranthias colonus*)
- Every video must be analysed by at least two analysts, one will identify the fish and a second person will measure individual fishes and confirm fish identifications.
- There is one working spreadsheet called **Progress Sheet** for each sampling campaign (Figure 2). Notice the columns in the spreadsheet have been colour coded to match this protocol. You will notice that you will not be able to edit some sheets and/or columns in this spreadsheet. This is because there is either a formula that automatically calculates values or there is reference information that will remain the same throughout this study. The **Progress Sheet** has six (6) sheets or tabs:
    1. **FieldDB** – sheet containing information gathered while on the field;
    2. **progr1-Interest-School-Gring –** it contains information about the overall progress for the analysis of species of interest, schooling fish, and gringos;
    3. **progr2- non Interest** – it only contains information for species of no interest to this project;
    4. **Disease sharks** – sheet used to keep track of the sites where hammerheads show signs of having a skin disease (**Figure *3***).
    5. **spp** – this sheet contains two lists:
        a. INTEREST SPP – list containing the fish families of interest for this study
        b. NON INTEREST – list containing the fish families that are **not** of interest to this project
    6. **Max Lngths for Cmm Sp –** maximum lengths for the most common species found at Darwin and Wolf islands. This information is useful for the Quality Control (see Quality control section).
- Videos, calibration (CAL) files, spreadsheets, manuals and all relevant documentation will be available on the server. If you do not have access to the server, ask the team leader.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	PROGRESS SHEET DOV-PROCESSING																	
2	Campaign (Month, Year):																	
3																		
4															Water temperature (°C)		Visibility (m)	
5	#	Island	Site	StereoVideo Set	GPS (1 or 2)	Date	Year	Month	Diver	Depth (m)	Census duration	Current (0 none, 1 little, 2 mod, 3 strong)	Mean temperature (°C)	Thermocline depth (m)	Over thermocline	Below thermocline	Over thermocline	Below thermocline
6	*Example*	*Wolf*	*Elefante*	*P2*	*2*	*2/2/2019*	*2019*	*2*	*Ty, Renato, Maarten*	*20*	*25*	*0*	*20*	*15*	*26*	*14*	*10*	*5*
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Figure 2 – Progress sheet example. Notice the spreadsheet has the six (6) tabs or sheets described in text.

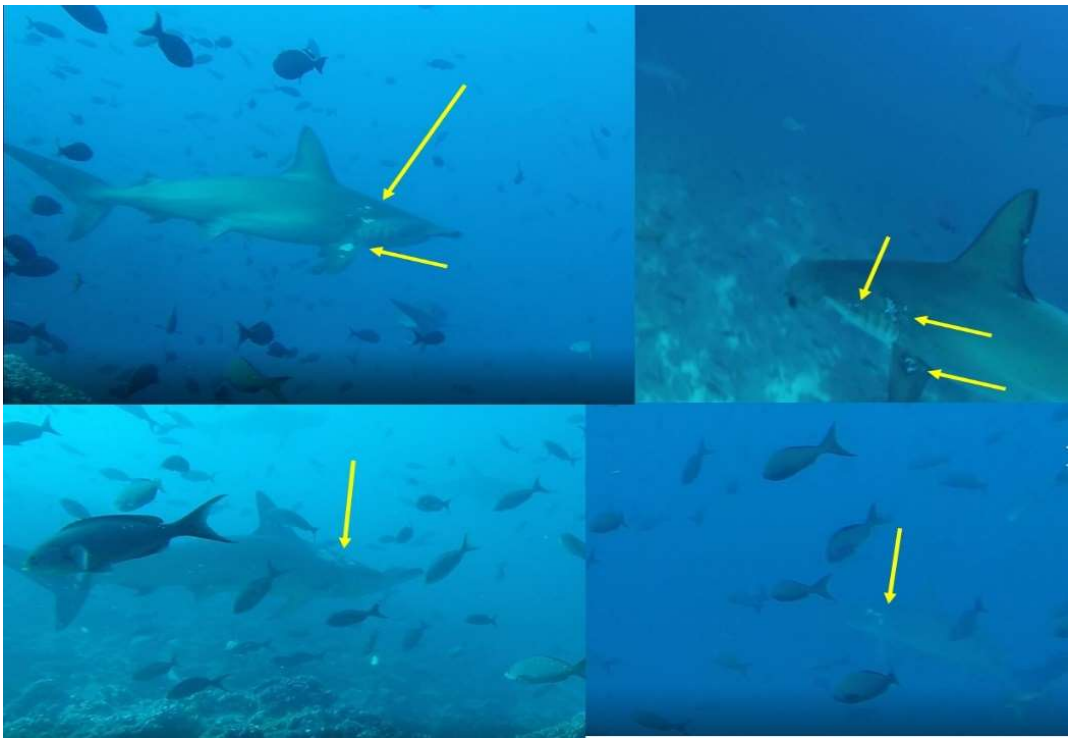


Figure 3 – Examples of skin disease in hammerhead sharks that must be recorded in the 'Disease sharks' tab of the Progress Sheet.

2 Data management – How to store data correctly

Because our project covers multiple years, it is extremely important that we standardise the way we record our data. This will help us significantly reduce the time it takes to prepare the data for statistical analysis. For this reason, we have established a structure and a naming convention

for all the data recorded as part of our Darwin and Wolf monitoring program, which is explained in detail in this section. Please, do not include additional folders or use different naming conventions for the files you produce while analysing the stereo-DOVs videos. If in doubt, ask your supervisor.

Backing up all data is also part of our data management plan and we must have at least two copies of all data for any campaign. All videos collected on the field will be saved in a portable hard disk, as well as the server. When you work on analysing videos, you will be given a portable hard drive with all relevant information related to a campaign. It is recommended that you copy the videos for the site you are analysing to your computer so you can work from your computer and not the hard drive as this may slow down video analysis. At the end of the day, you must make a copy of any files you have created as part the analysis into the portable hard drive given to you, even if you have not finished analysing the entire video. Remember, there **must be two copies** of any file related to this campaign.

2.1 How to store data – Folder structure and naming conventions

The same folder structure must be applied to all campaigns and to all copies of the data. This folder structure must be created before any video analysis takes place.

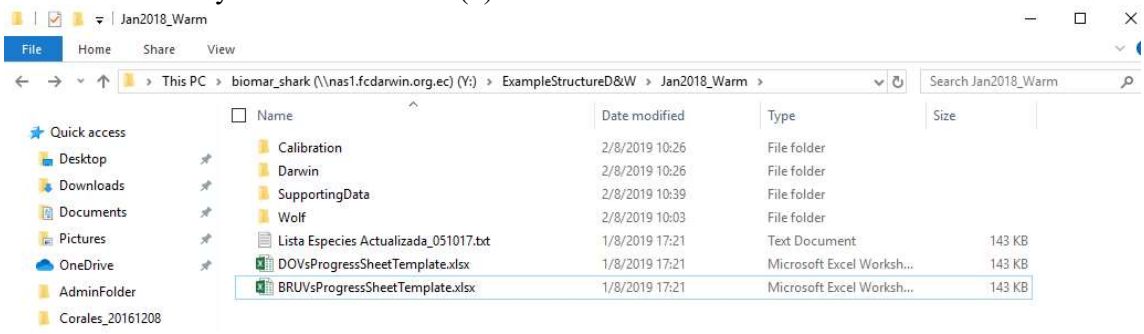
- Use the *DOVsProgressSheetTemplate.xlsx* found in NAS1:\Common Resources\Projects\SHARK SURVEYS\DOVS to create a spreadsheet in Google Drive. This spreadsheet will be saved as ProgressSheet, followed by an underscore, and the month and year of the campaign (e.g., ***DOVSProgressSheet_Dec2016***). Note that once the analysis is completed, a copy of this spreadsheet will need to be included in the server and secondary backup.
- If you do not have access to NAS1, speak to your supervisor.

The folder structure and naming conventions for the Darwin and Wolf shark monitoring project is explained in detail below. All folders in the NAS servers will have the same structure regardless of when the campaign took place. Although, you will analyse videos in your computer (the Desktop or Documents folder is a good place to save your work), you will need to apply the same structure and naming convention to any files you create. Do NOT add or delete any folders or files into the servers before talking to your supervisor. You can however, create temporary files that you may find helpful while performing the video analysis, but these files will not be saved to the server unless a supervisor has approved this beforehand.

Before starting the video analysis, create the folder structure described below:

- Create a new folder for the campaign you are about to analyse and name it using the three initial letters of the month and four digits for the year of the campaign followed by an underscore and the season. For example, ***Jan2018_Warm***.

- Inside this folder you will create four (4) new folders as shown in



- Figure *4*:
    - **Calibration**, which contains all information related to the calibration of the stereo camera sets used for the campaign
    - **Darwin** and **Wolf**, where you will save videos and information related to the analysis of videos
    - **Supporting data**, additional information that may be useful for video or data analysis, including CTD and GPS data, sampling and tagging log spreadsheet, and any relevant publications
- In the campaign folder you will also find the DOVs and BRUVs progress sheets and a copy of the most up to date species list.

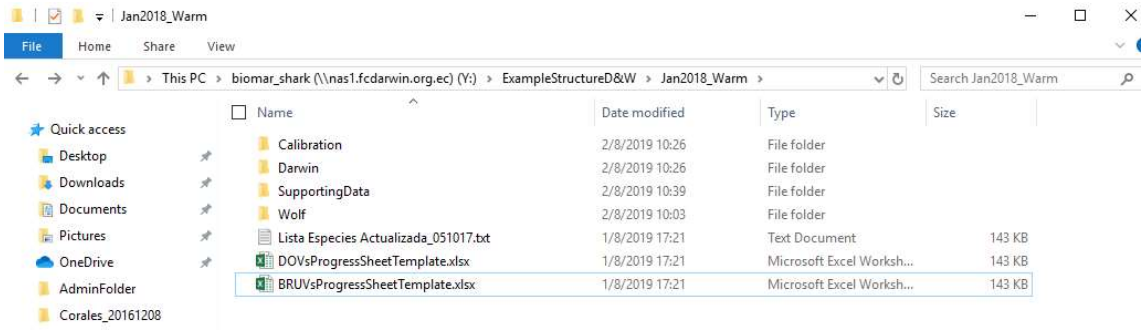
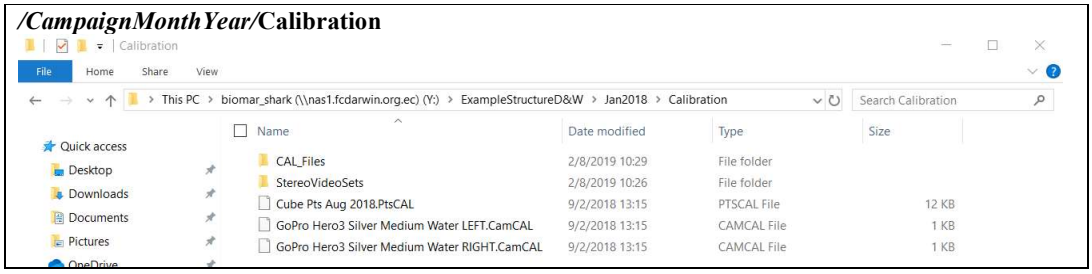


Figure 4 – Folders and files within the folder with your name and campaign (e.g., Jan2018_Warm).

2.1.1 Calibration folder

Figure 5 shows the structure and naming conventions that should be applied within it. An explanation of each folder and/or file is given below.



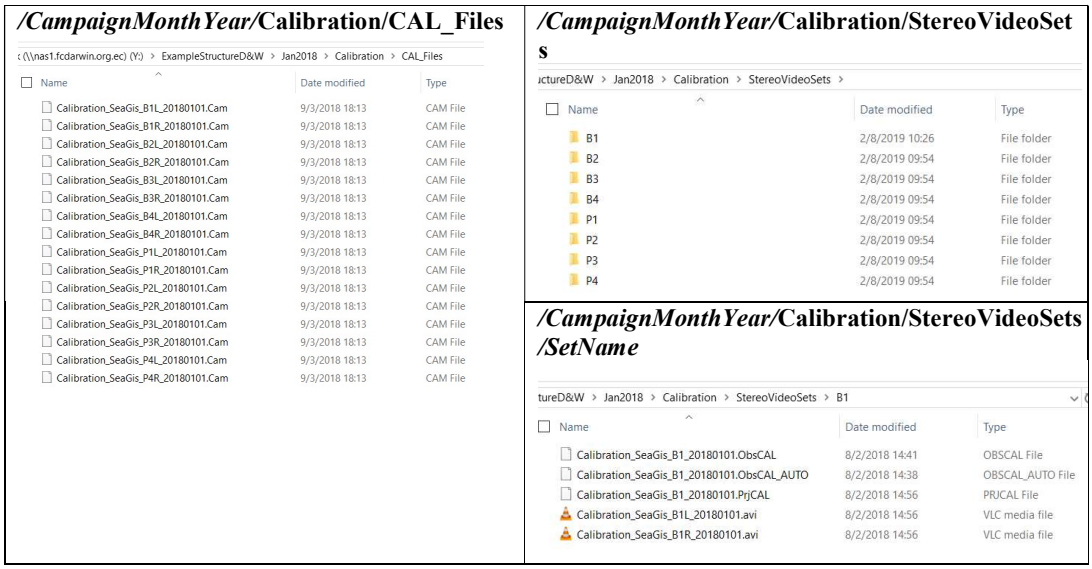


Figure 5 – Structure of **Calibration** folder. The file names show the naming convention that should be applied to all files within that folder.

Folders:

- **CAL_Files** folder contains final calibration files to be used when analysing DOVs and BRUVs videos. There should be two files (left and right) per camera set used in the campaign. The files should be names as follows: Calibration_*StereoVideoSetType (GoBenthic or SeaGis)*_*StereoVideoSetNumberAndSide (e.g., B1L, B1R, P2R, B3L, etc.)*_*DateOfCalibration(international format: YYYYMMDD)*.
- **StereoVideoSets** folder will contain one folder for each camera set used in the campaign (e.g., B1, B2, P3, etc.). The total number of folders in **StereoVideoSets** will be exactly half the number of calibration files found inside **CAL_Files**.
    - Inside each video set folder, you will find two converted video files, one for each camera in the set (left and right), and three files produced during the calibration of each set. The naming convention is the same as the one described in **CAL_Files** above.

Files:

- A copy of the latest cube point file, which can be found in NAS1:\Common Resources\Projects\SHARK SURVEYS\. This file will be named something similar to *Cube Pts Aug 2018.PtsCAL*.

A copy of the camera characteristics calibration file for each side of the stereo video set. This file is unique to each camera type (e.g., GoPro Hero 3, GoPro Hero 4, etc.) and settings (e.g., Medium field of view).

2.1.2 Island folders (Darwin & Wolf)

Both folders have the same structure and naming conventions (Figure 6), the only difference will be in the names of the sites, which do vary between islands.

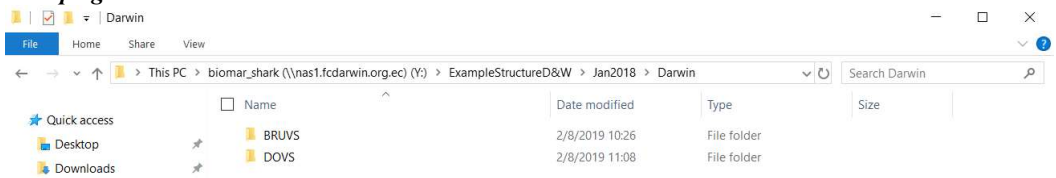
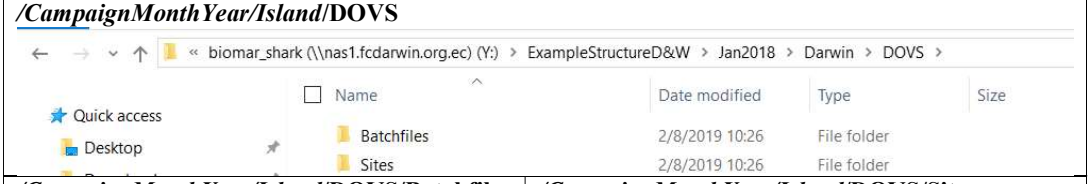
Folders:

- **BRUVS** contains videos and any files produced during the analysis of stereo-BRUV videos. For more information on the specific structure of this folder, refer to the Protocol for BRUVs Analysis.
- **DOVS** folder contains videos and files produced during the analysis of stereo-DOV videos.

2.1.2.1 DOVS folder

Figure 6 shows the structure and naming conventions that should be applied within this folder. There should be two folders here:

- **Batchfiles** contains the text files produced by EventMeasure containing all counts and measurements of all videos analysed. In here you will have two folders, counts and measurements, each will have a different type of batchfile. The number of files inside each folder will depend on the number of sites sampled at each island, so it would be 8 files per folder in Darwin and 9 files per folder in Wolf:
    - **Counts** folder. It will contain abundances per species of fish identified at each site around the island and a summary including all sites around each island. There should be 8 files for Darwin (7 sites plus one summary.) and 9 for Wolf. Files containing information about sites should be named *SiteName_MonthYear (three first letters of the month and four digits for the year of the campaign)*_Counts, for example: **Banana_Jan2018_Counts.txt**. While, the summary file should include the name of the island instead of the site names as follows: **Wolf_Jan2018_Counts.txt**
    - **Measurements** folder will contain measurements for individual fish. The number of files and naming convention are the same as above, with the difference that we use 'Measurements' instead of 'Counts' when naming the files, for example: **Elefante_Jan2018_Measurements.txt** (site file), and **Darwin_Jan2018_Measurements.txt** (island summary file).

<table>
<tr><td colspan="2">/CampaignMonthYear/Island
 
</td></tr>
<tr><td colspan="2">/CampaignMonthYear/Island/DOVS
 
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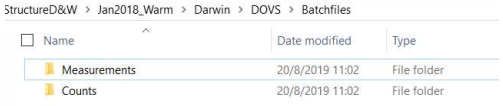
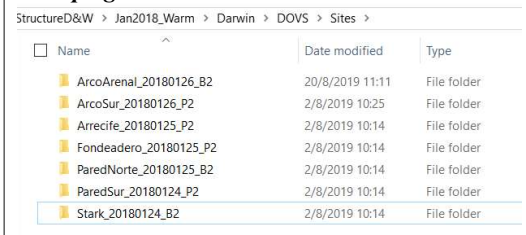
 
</td><td>/CampaignMonthYear/Island/DOVS/Sites
 
</td></tr>
<tr><td>/CampaignMonthYear/Island/DOVS/Batchfiles/Measurements</td><td>/CampaignMonthYear/Island/DOVS/Sites/SiteName</td></tr>
</table>

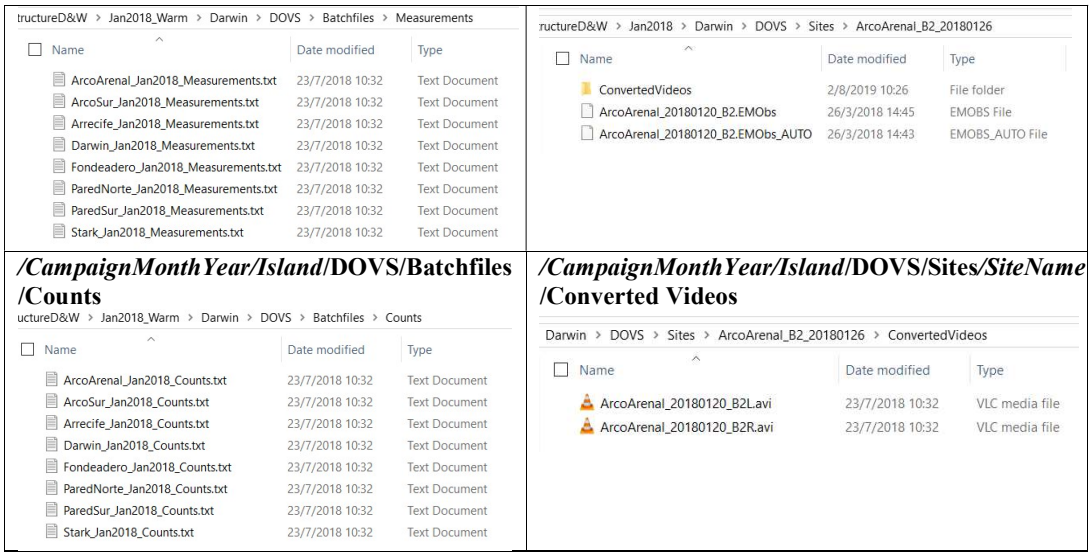
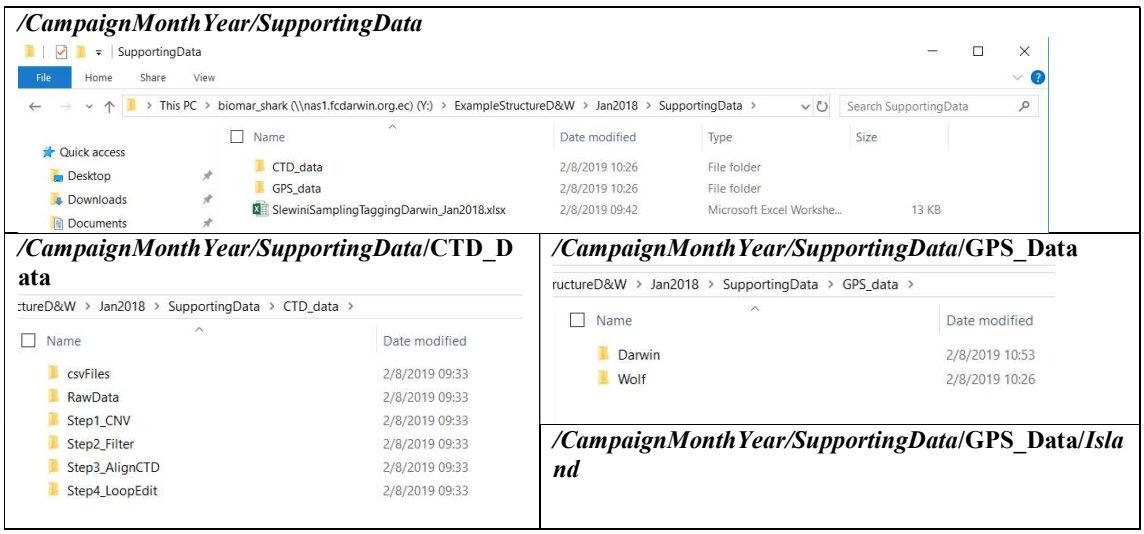


Figure 6 – Structure of the islands and DOVS folders. The file names show the naming convention that should be applied to all files within these folders.

- **Sites** folder contains one folder per site sampled, there should be 7 for Darwin and 8 for Wolf. These subfolders should be named *Sitename _SamplingDate(YYYYMMDD) _StereoVideoSetUsedToSampleSite*, for example, **Arrecife_20180120_B2**. Inside these subfolders you will have two *EMObs* files and a folder named **ConvertedVideos**, which will have two videos (right and left) obtained at that particular site. The EMObs files will be named *Sitename_ SamplingDate(YYYYMMDD) _StereoVideoSetUsedToSampleSite, for example,* **Stark_20180120_B2.EMObs**. The video files will follow the same pattern, but they will also have an L or R to next to the stereo video set to represent where it was the left or right camera, for example **Stark_20180120_B2L.avi**.

2.1.3 Supporting Data folder

Figure 7 shows the structure and naming conventions that should be applied within this folder. An explanation of each folder and/or file is given below.



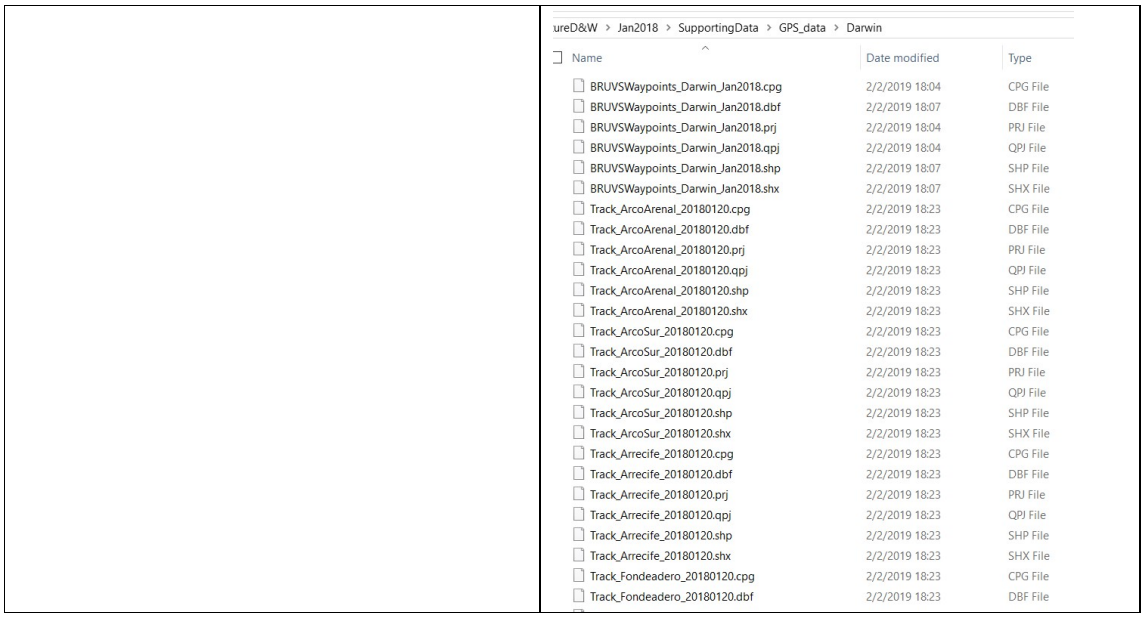


Figure 7 – Structure of the Supporting Data folder. The file names show the naming convention that should be applied to all files within these folders.

Folders:

- **CTD_Data** contains all data files downloaded from the CTD after the sampling has been completed. The CTD data must go through a multi-step processing before it can be used in any statistical analysis. Information about this process can be found in NAS1:\Common Resources\Projects\SHARK SURVEYS\CTD.
- **GPS_Data** contains data collected on the field with the GPS units. Inside this folder, there should be two folders, one for each island. Inside the island folder, you should have a file containing waypoints for BRUVS deployments around the island, and either 7 or 8 files containing the tracks for each DOVS transect. BRUVS files should be named BRUVSWaypoints*_Island_DeploymentMonthAndYear* (BRUVSWaypoints_Wolf_Jan2018.shp), while the DOVS files should be named Track*_SiteName_DeploymentDate* (Track_Banana_20180125.shp). The process of accessing and saving the spatial data is explained in Section 5 - Analysing stereo-DOVs videos.

Files:

- **SlewiniSamplingTaggingDarwin**, which contains information about any sharks that were tagged, sampled or both. This file should only be included in the **Supporting Data** folder if samples were collected or tags placed on animals. A copy of this spreadsheet can be found in NAS1:\Common Resources\Projects\SHARK SURVEYS.

Remember, this folder structure must be created before any video analysis takes place.

3 Converting stereo-videos using Xilisoft Video Converter

Xilisoft Video Converter is a program used to convert video files between different formats, mostly to compress these video files. We also use this software to stitch together the MP4 all

files produced by GoPros during a single camera deployment. We prefer to work with AVI files because they are better handled by EventMeasure and CAL.

3.1 Installing or renewing Xilisoft licence in your computer

All files you need for the installation of Xilisoft in your computer can be found at NAS1:\Common Resources\UsefulSoftware\VideoConversion.

If Xilisoft is NOT installed in your computer:

- Perform a standard installation using the *XilisoftVideoConverter.exe* found in the Common Resources folder in the server. If asked, choose the default installation settings.

If Xilisoft is installed in your computer:

- Open Xilisoft and you will be prompted to enter a License Key to use the software. If you're not asked for a license or accidentally close this window, you can access it through the main menu *Help -> Enter License Code*.

In all cases:

- To obtain a License Key click on the *Keygen.*exe file in the Commom Resources folder. Click *Run* if prompted. Once the program opens, click *Generate code* and this will create a new license key that you can copy and paste into Xilisoft. Use **Black Riders** as your User Name. If the license key is not accepted by Xilisoft, you may need to click either the *Remove x64 Reg* or *Remove x32 Reg* (depending on the number of bits your Windows runs) before generating a new code.

3.2 Creating a stereo-video profile

Before converting any videos, you need to create a profile that will save the settings that you will need to apply to all videos to be converted. This way you will avoid having to load the same settings every time you convert videos.

- Click on the *Profile* dropdown list located at the bottom the window (Figure 8). Click on *HD video -> HD-Xvid Video.*

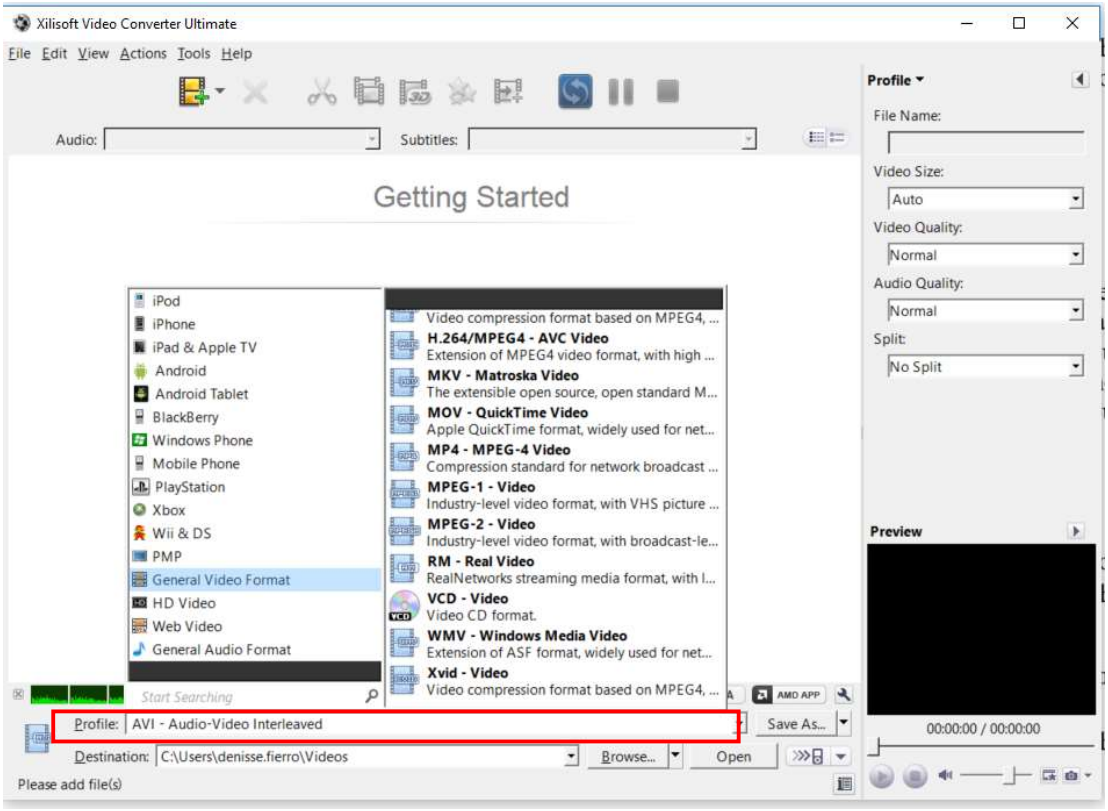


Figure 8 – Xilisoft window highlighting the *Profile* dropdown list in red.

- To change the conversion settings of this new profile, click on the arrow next to *Profile* in the right panel (Figure 9). Click *Video stream* from the dropdown list.
- Fill all fields with the same information shown Figure 9.

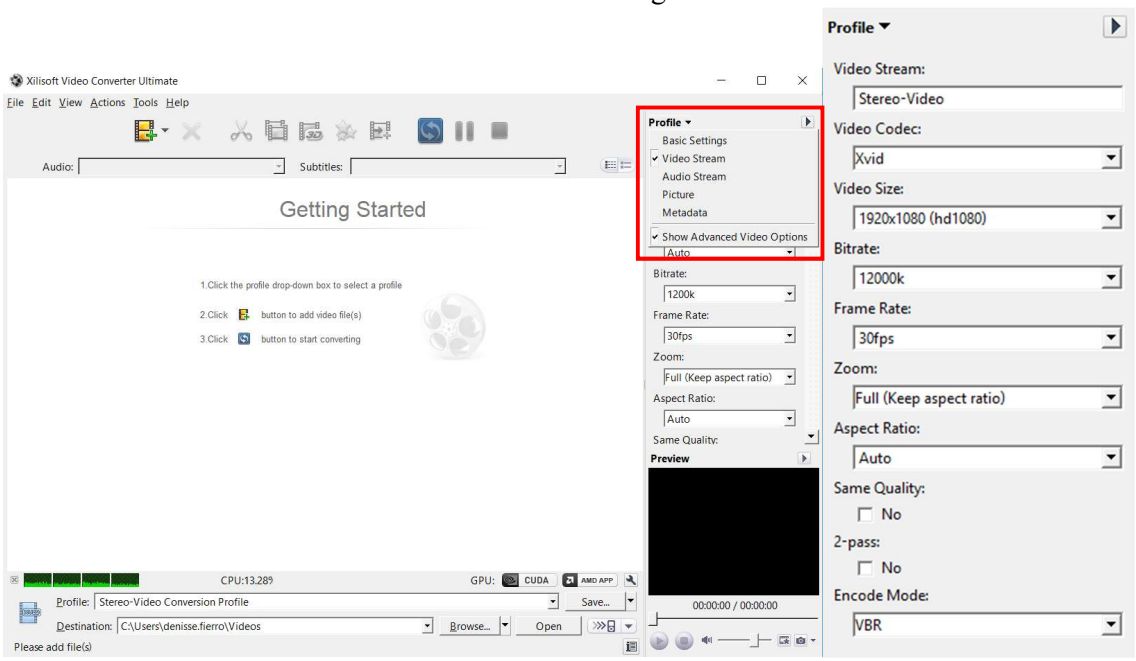


Figure 9 – Location of *Profile* panel highlighted in red (left). On the right, a zoomed in picture of the same panel showing the correct settings for the new profile being created.

- Click on *Save as* in the bottom section next to the *Profile* dropdown list (Figure 8). When prompted, name the new profile **Stereo-Video Conversion Profile**.
- Now the new profile will be available under *Profile -> User Defined*.

3.3 Load and convert video files

It is worth noting that left and right videos will need to converted separately.

- Select *Stereo-Video Conversion Profile* under *User Defined* from the Profile dropdown list.
- Using either *File -> Add File(s)* or the *Add File(s)* button (Figure 10), import the video files to be converted. Remember to only include videos for one side at a time. Furthermore, the videos need to be uploaded sequentially with the starting video at the top.
  Note: when processing DOV videos, you will select ALL videos available. However, when processing BRUV videos, you will select videos that will give you a total bottom time (i.e., from where the BRUV system settles in the substrate) of 1h 45m.
- All imported videos will appear on the main window. Select all files and combine them by either using *Edit -> Merge Selected Items Into One* or by clicking the *Merge* button in the top panel.
- Once the merging is done it will appear in the main window. Delete any individual parent files, leaving only the recently created merged file or *Joint Item*.
- In the *Destination* box (Figure 10) you can either copy and paste the destination of your video, or use the *Browse* button to select the folder where the converted video will be saved. For information on where to save the converted videos, as well as the correct naming convention refer to Section 2 - Data management – How to store data correctly for more information. Example destination file and correct name: **Jan2018\Darwin\DOVS\Sites\ArcoArenal_B2_20180126\ConvertedVideos\ ArcoArenal_20180120_B2L.avi**.

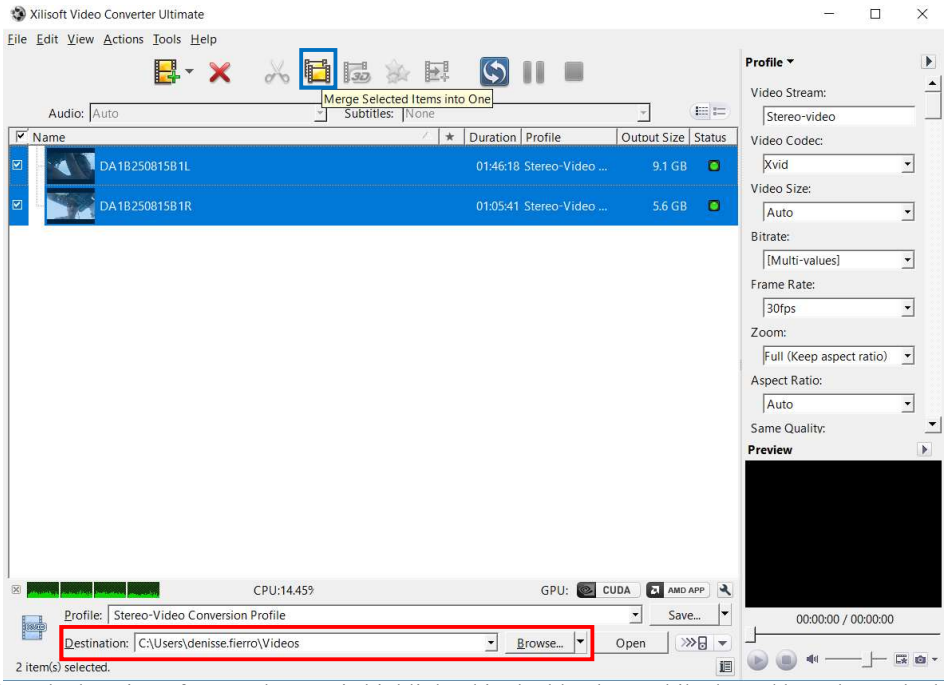
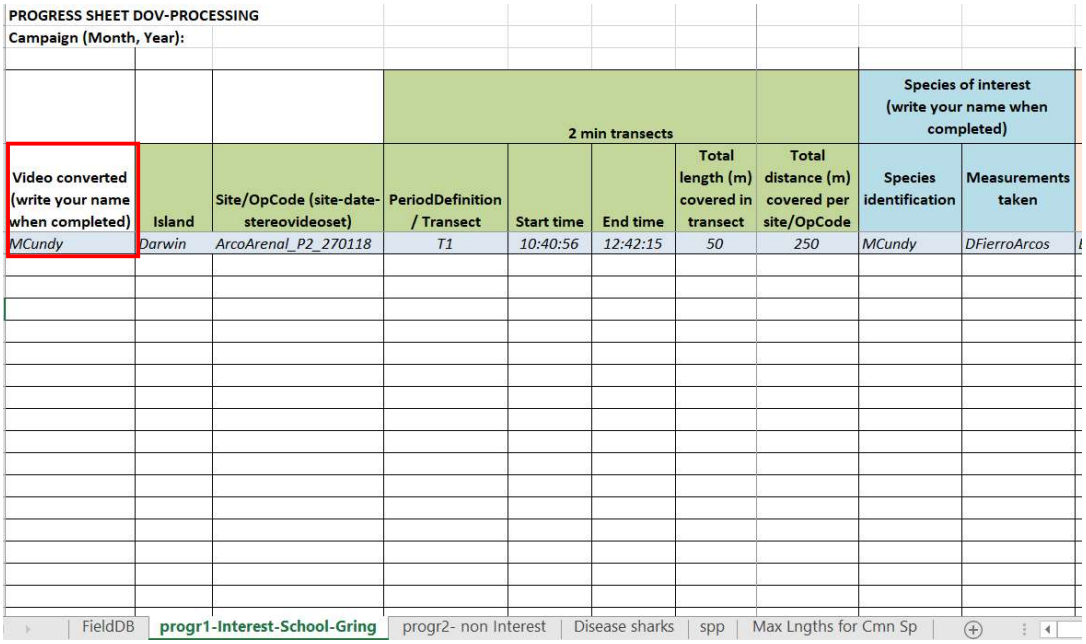


Figure 10 – The location of *Merge* bottom is highlighted in the blue box, while the red box shows the location of the *Destination* dropdown list.

- Ensure the merged video is selected and click the *Convert Checked Items* button (white arrows on blue background) to start the conversion. The converted file will be saved in the destination folder automatically.
- Before closing the program, check the output file is fully functional by opening it using VLC Media Player (or similar video player) and that it was merged correctly. Also ensure that the video file has an .avi extension. If you have any problems opening the file or find errors in the video, delete the output and start over.
  Note: If this is the first time you are converting videos, or if it is the first time a particular computer is used for video conversion, it is worth checking that the converted videos work in EventMeasure. Load the videos and attempt to do a couple of measurements to ensure the videos can be used in this software.
- Once the video has been thoroughly checked, you can delete the unconverted files.
- **Remember:** You must record your name next to the videos that have been successfully converted in the 'progr1-Interest-School-Gring' sheet of the **DOVs Progress Sheet** shared in Google Drive (Figure 11).



PROGRESS SHEET DOV-PROCESSING
Campaign (Month, Year):

			2 min transects					Species of interest (write your name when completed)	
Video converted (write your name when completed)	Island	Site/OpCode (site-date-stereovideoset)	PeriodDefinition / Transect	Start time	End time	Total length (m) covered in transect	Total distance (m) covered per site/OpCode	Species identification	Measurements taken
MCundy	*Darwin*	*ArcoArenal_P2_270118*	*T1*	*10:40:56*	*12:42:15*	*50*	*250*	*MCundy*	*DFierroArcos*

FieldDB | progr1-Interest-School-Gring | progr2- non Interest | Disease sharks | spp | Max Lngths for Cmn Sp

Figure 11 – Screenshot of the **DOVs Progress Sheet**, the red box highlights the column that must be completed once videos have been successfully converted. If videos could not be converted, simply write *Cannot convert*.

Note: If videos could NOT be converted, you will have multiple small MP4 files that make up a complete RIGHT or LEFT video. If this is the case, you will still need to name these files following the naming convention described in Section 2 - Data management – How to store data correctly. The only difference is that you will need to add a number at the end, which will mark videos sequentially. For example, if you have four videos making up the entire LEFT video for Arco Arenal in 2018, you should have four MP4 video files named as follows: **ArcoArenal_20180120_B2L_1.MP4**, **ArcoArenal_20180120_B2L_2.MP4**, **ArcoArenal_20180120_B2L_3.MP4**, and **ArcoArenal_20180120_B2L_4.MP4**.

3.4 Common errors to avoid while using Xilisoft

The L and R videos were incorrectly labelled
Check file names after merging the MP4 videos. Ensure the file name matches with the video view and with the name that you wrote down in any notes you took.

Wrong profile in Xilisoft
Ensure you are using the correct profile before converting any videos, particularly if you just opened the program.

Videos conversion suddenly stops and an error mark appears
There are two possible reasons for this error:

- The size of the videos is too large and the program cannot convert them.
- Too many videos are being converted at the same time. You have to wait until others video conversions are completed before starting a new one.

Some videos finish converting but when checked the video has a decompression problem
There are two possible reasons for this error:

- You are converting too many videos at once and the program is not able to convert them properly.
- One of the MP4 videos may be too big for the program to convert
- One of the MP4 videos is corrupted or the camera had a problem while filming.

In all this cases, you could change to a different video conversion program or check with your Supervisor if the profile settings need to be changed.

4 Calibration of camera systems

Each stereo-video set, which includes the housing rigs and two cameras, must be calibrated independently. This is because the calibration will vary depending on the separation between cameras, the angle of each camera housing and the distortion of each camera lens. To calibrate these systems, we need a specialized calibration cube and the CAL software from SeaGis. Calibrations are done inside a pool and we need the pool water to be as clear as possible to facilitate the processing of calibration files.

Stereo-video units must be calibrated prior to carrying out a sampling campaign to ensure measurements of individual fishes are precise. Calibrations may need to be repeated after finishing a sampling campaign if we suspect a camera has moved while handling the set, or if a camera has been replaced in a set due to equipment failure.

It is important to remember that we CANNOT complete a sampling campaign if calibrations of ALL stereo-sets used are not done first.

4.1 Calibrating stereo-video sets

Calibrations are currently done at Hotel Fortaleza de Haro (Petrel and José de Villamil, El Edén neighbourhood), which is located about 2 km away from the Charles Darwin Research Station. Figure 12 shows the location of the hotel, as well as car directions from the office.

Calibrations must be done no less than one week before fieldwork is due to begin. You will need at least three people to do calibrations, two people will be in the pool with the cube, while the third person will prepare the cameras and check the videos (i.e., check that both cameras recorded video and that the entire cube can always be seen in the frame).

While in the pool, the two team members will rotate the calibration cube with white dots in five (5) different positions. For a detailed description of these positions refer to Appendix A – Calibration Cube Orientations (page 65) of the CAL User Manual available in at

NAS1:\Common Resources\UsefulSoftware\StereoVideos\CAL. Page 69 of the same manual has photos of the different cube positions.

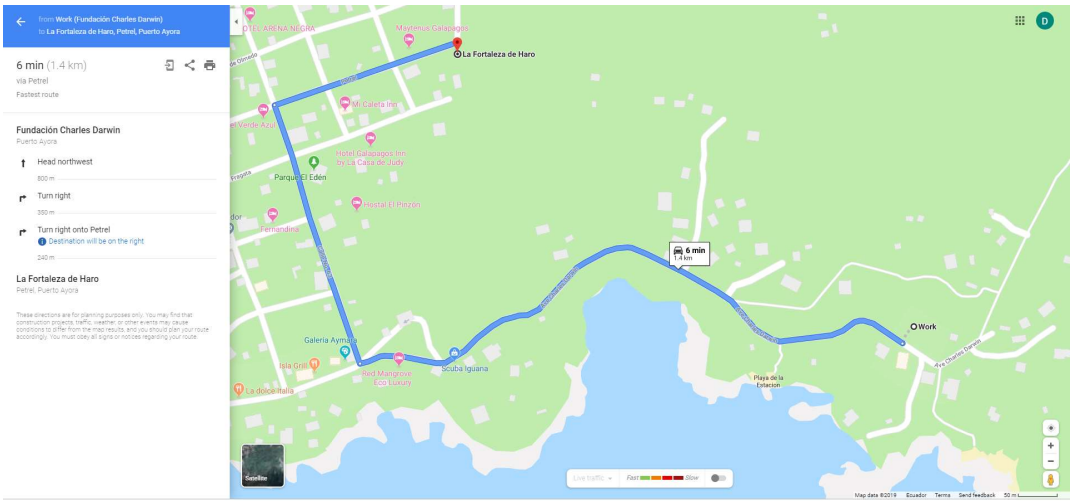


Figure 12 – Directions to Hotel Fortaleza de Haro, where calibrations are currently done, from Charles Darwin Research Station. You can click on the map to find the address in Google Maps.

4.1.1 Checklist to organise calibrations

- Book the pool at Hotel Fortaleza de Haro by calling either Mrs. Gianna Haro (0991406619) or Mr. Roberto Haro (0994786120). Enquire if pool has been recently cleaned to ensure water is as clear as possible.
- Once pool has been confirmed, book a car with the Maintenance team. You will need to complete the Car Booking Form that can be found at NAS1:\Common Resources\Admin\FormsFCD\ and send it to them via email at least two business days before the date you plan to use the vehicle.
- All new staff must go through Appendix A – Calibration Cube Orientations (page 65) of the CAL User Manual and check the two videos available at NAS1:\Common Resources\UsefulSoftware\StereoVideos\CAL, so they understand the movements of the calibration cube in the pool.
- On the day of calibration, you will require the equipment listed in Table 1 below. Make sure the equipment is prepared and stored for transportation the day before calibration. Remember that the cameras must be placed at least 2.5 m away from the calibration cube.

4.1 Analysing calibration videos using CAL software (Quick guide)

This section seeks to provide a quick guide for the calibration process of stereo-cameras. For a detailed description of this process you can refer to the CAL User Manual, which can be found in NAS1:\Common Resources\UsefulSoftware\StereoVideos\CAL.

Before the calibration process can begin, you will need to make sure that the CAL software package is installed in your computer. Additionally, you will need to have the USB key which contains the licence for CAL.

4.1.1 Making point measurements

Measuring points are the base operation to perform a calibration. For this reason, you must do this very careful to ensure the resulting calibration is accurate. Usually, you will only need to measure four point manually, these are called the resection points (Figure 13). Once the resection points have been identified, the remaining object points are measured automatically.

However, if visibility is less than ideal, then you will need to identify and measure all points manually.

Table 1 – Gear list needed for calibrations of stereo-video sets.

Item	Location	Quantity
Calibration distance bar	doll house	1
Calibration cube	doll house	1
Stereo-video sets	bodega	4 or 8
GoPro cameras	Storeroom	4 or 8
Weights		min 10
Weight belts (if wearing a wetsuit)	Storeroom	1 per person
Plastic boxes to store equipment	doll house	2
Gloves	doll house	2 pairs
Measuring tape	doll house	1
Beach towel to place under the calibration cube	doll house	1
Mask, snorkel, rashie, wetsuit (if needed)	Personal equipment	1 set per person
Box with small clips to close SeaGIS housings	Office	1
Go Benthic housing spare parts	Office	Ziplock bag
Silicon grease	Office	1
Plastic tweezers	Office	1
O-rings (spares)	Office	Ziplock bag
Paper towels	Office	2
English key	Office	2
Drill	Office	1
Computer to view videos	Office	
Allen keys grey kit	Office	1
SD card multiplier for computer	Office	At least 2
SD cards in orange box	Office	1
Hat, sunscreen and towel	Personal equipment	1 set per person
Water and snacks	Personal equipment	1 set per person

The calibration cube has a total of 41 white points in its frontal face, each of which has a specific point number assigned to it (Figure 14). To find the point number of any white point, you must first locate the white bar in the calibration cube. The point immediately to the left of the white bar is resection point 100 (Figure 13).

Remember that points must be identified in both the left and right video frames, so you must choose a frame where all points are visible in both cameras frames.

- Locate the four resection points (Figure 13) in the video frame as explained above. You will the measure these points either *manually* or by using *centroiding*. *Centroiding* is the preferred method of point measurements because it offers much better accuracy.
    - To manually measure each resection point, clicking in the centre of each point.
    - To apply the *centroiding* method, you will position the pointer of your mouse over the centre of the point to be measured, and while holding the *Shift* key, press the left mouse bottom down (do NOT move your mouse).

  Regardless of the method used to identified the points, you must measure these points in ascending order from 100 to 104 as the program assigns the point numbers automatically. You can zoom into the video frame if you need to locate the centre of the object point.

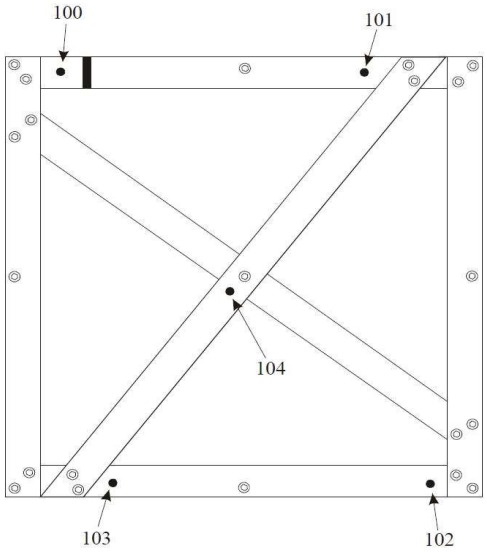


Figure 13 – Schematic representation of the front side of the calibration cube showing only the four resection points and its corresponding point numbers, as well as the bar indicating the location of the first resection point (100).

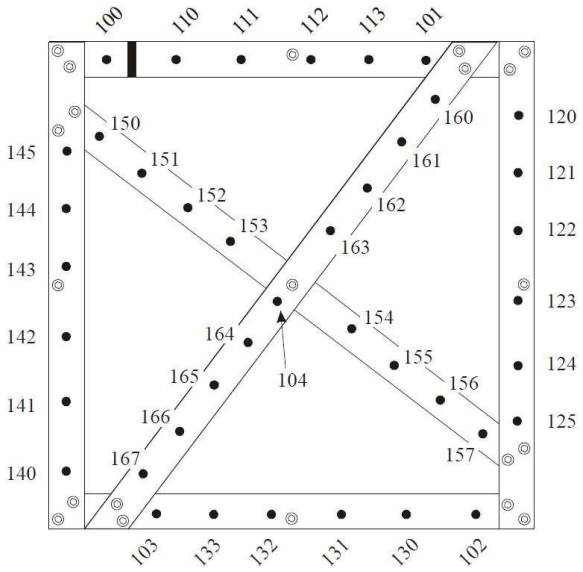


Figure 14 – Schematic representation of the front side of the calibration cube with the complete set of points and its corresponding point number.

- Once the four resection points have been identified in both video frames (left and right), you can identify the remaining object points (Figure 14) either manually or by using *centroiding* as explained in the previous point. After this process is completed, the image should be automatically resected.
  Remember, object points have to be identified in an ascending order based on the point number shown in Figure 14.
- Check point numbers identified in the CAL screen match those shown Figure 14. If a point number is incorrect, you can edit the number by right clicking the point. A new window will be displayed, here you can retype the correct the point number. You also have the option to delete a point from this window by clicking the *Delete* button.

Note that this process must be repeated for each cube position described in Appendix A – Calibration Cube Orientations (page 65) of the CAL User Manual (available in NAS1:\Common Resources\UsefulSoftware\StereoVideos\CAL). This means that you should have 20 images for each camera (i.e., 20 for the left camera and 20 for the right camera).
To ensure calibrations are accurate, it is helpful to have the *Data View* window open, as the *No. of points* section of this window will tell you the total number of points currently identified in your video. You need no less than 60 points before a calibration can be processed, but having more than 80 points increases the quality of the final calibration.

4.1.2 Starting a new project

A project is a file that stores filenames and any information related to the calibration you are about to begin. It is important that you save this project file regularly to ensure you do not lose any data you have been working with. To create a new project, follow these steps:

- In the main menu, click on *Project -> New Project*. A window asking to save the current project opens, click *Cancel*. A new window will open asking you to write the name of the new project. Select the file directory where you want to save your work. This should be inside the calibration folder the sampling campaign you are about to analyse (see Section 2 - Data management – How to store data correctly for more information). Click on "Save it". Remember, the naming convention for these files is Calibration_*StereoVideoSetType (GoBenthic or SeaGis)*_*StereoVideoSetNumber (e.g., B1, P2, B3, etc.)*_*DateOfCalibration(international format: YYYYMMDD)*. For example, **Calibration_SeaGis_P1_20170427**, **Calibration_GoBenthic_B1_20170427**.
  After you have saved the new project, three new files with the name you previously typed appear in the folder you selected in the previous step with the name. These files will have three different extensions:
  - One project file with a *.PrjCAL* extension
  - One measurement files with a *.ObsCAL* extension
  - You will also see a file with extension *.ObsCAL_AUTO*, which allows the project to be automatically loaded into CAL when you open this software.
- After your Project has been saved correctly, you will be asked to select the camera files for the left and right cameras. If you are not prompted to do so, click on *Camera -> Left -> Read from file*. Select the folder where this file is located. To upload the right camera file, click on *Camera -> Right -> Read from file*.
  - The camera files have a *.CamCAL* extension and should have been given to you by your Supervisor, and they should be saved in the Calibration folder of the campaign you are analysing (refer to Section 2 - Data management – How to store data correctly for more information).
  - If you have previously calibrated the stereo-video set using the same camera model, then it is recommended you use the camera files from the previous calibrations. This is because this file will already contain more accurate camera parameters for that particular set.
- Upload the object point file for the calibration cube, which contains the coordinates and distances specific to our calibration cube. On the main menu, select *Objects Points -> Read from file*. Select the folder where this file is located.
  - As with the camera file, the object point file should have been given to you by your Supervisor and it should be located in the Calibration folder. This file should have a *.PtsCAL* extension.

4.1.3 Loading videos and synchronising

Once you have saved your project and uploaded the camera and object point files into CAL, you are ready to upload the videos taken by the stereo-video set being synchronised. Note that videos must have been converted to .avi beforehand. It is also recommended that you turn the sound off by clicking the *Sound* button, the X means the sound is off.

- Select the folder containing the videos that will be used in the analysis. This folder should have the stereo-video set as its name and it should be located under Calibration/StereoVideoSets. If unsure refer to Section 2 - Data management – How to store data correctly for more information:
    - In the main menu, click on *Picture -> Set Picture Directory*. Now you can select the folder where videos are saved.
- Before uploading videos, ensure the *Lock* box is unchecked to stop CAL trying to maintain synchronisation while the videos are loaded. Upload videos for each camera in the stereo-video set. Ensure you select the right video for each side. The Left video should have L in its name (e.g., **Calibration_SeaGis_B1L_20180101.avi**), and the Right video should have R in its name.
    - In the main menu, click on *Picture -> Left -> Open Picture -> Define Movie Sequence*. Select the left video.
    - In the main menu, click on *Picture -> Right -> Open Picture -> Define Movie Sequence*. Select the right video.

  Note: When you load a video, CAL checks that its dimensions match the current camera parameters. If they do not match, a warning message will appear. Do NOT ignore this warning as these should match for the calibration to be accurate. Instead, check that you are using the correct camera file by clicking on *Project -> Display/set current project data.*

Once both videos are uploaded, you are ready to synchronise them. This means that both videos should be locked in such a way that they both show the exact same point in time. You can use the built-in player to do this.

- To synchronise the videos, find the frame with the applause sequence in both videos. You can slow down the videos using the *Rate* box above the player or use the left and right arrow keys to advance one frame at a time until you find the frame in both videos, where they show the exact same point in time. Once you are happy with the frames, lock them by ticking the *Lock* box. Note that if you are using the movie player, you must click *Close player and update position* before you can see lock the videos.

If you want to check all settings in your project are correct, a summary of the current project file settings can be seen by clicking on *Project -> Display/set current project data*. A window will appear showing the current project file name, picture directory, camera files, as well as the measurements and object point files. If you spot any mistakes, you can correct them now by following the steps previously described.

4.1.4 Setting adjustments

The default adjustment parameters are will be used for the generating the camera files. There is no need to change any of these parameters. Simply continue to calculate the bundle adjustment. We first calculate an *Initial solution*, followed by a series of *Re-weighting solutions* (at least two additional adjustments) where poor adjustments are removed. Once re-weighting is completed, we will get the *Parameter precisions and correlations* needed to generate the camera calibrations.

- Compute the bundle adjustment by clicking on *Adjustment -> Compute bundle adjustment*. A new window appears showing the progress of this process, which includes a sigma zero value. This value is related to the quality of the adjustment and should be as close to 1 as possible. This computation has two possible results:
    - **Adjustment SUCCEEDED**. Check the results make sense and click *Accept*.
    - **Failed**. Review all items listed in your screen to find the reason for the failure. The most common ways to fix failures include:
        - Ensuring you have at least 60 points, preferably over 80 points. Remember that higher accuracy is often linked to a higher number of points
        - Checking that you have the same number of frames for the left and right cameras
        - Checking that all points in all images related to the current project have been numbered correctly as shown in Figure 14
        - Ensuring points in your screen are actually placed in the centre of the white points in the calibration cube
        - Confirming the correct camera files have been loaded to the project
        - Double checking that videos have been correctly synchronised

      Apply the above changes and re-run the bundle adjustment computation until you have a successful result.
- Once you get a successful result, do the following:
    - In your screen, you will be shown all the points included in the computation of the bundle adjustment. The points are colour coded to reflect its level of accuracy, green points are good, yellow are not very good, and red means they were rejected.
    - Delete rejected measurements using *Measurement -> Delete rejected point measurements*. Try to re-mark the now deleted points to increase their accuracy. If possible, do the same for the yellow points. Compute the bundles again by clicking on *Adjustment -> Compute bundle adjustment*.
    - Search for missing targets using *Measurement -> Find targets in all images*
    - Compute another bundle adjustment using *Adjustment -> Compute bundle adjustment* and click on *Accept results*.
    - Delete rejected measurements using *Measurement -> Delete rejected point measurements*
    - Compute a final bundle adjustment using *Adjustment -> Compute bundle adjustment* and click on *Accept results*.

4.1.5 Generating stereo camera files

All the menu operations described in this step can be found under *Measurement -> Stereo constraints.*

- Configure the stereo constraints using *Configure stereo constraints.* Ensure the *Left camera* and *Right camera* are properly selected in this dialog box, then click the *Automatic* button to generate the left/right image pairings. Check these image pairings are correct.
- Estimate constraints using *Estimate constraints*.
- Check the relative orientation using *View stereo constraints*. Check if constraint residuals are acceptable, and that not too many constraints have been excluded from the calculation in the *Exclusions column*. **If more than around four (4) constraints are listed in the *Exclusions column*, re-check the stereo synchronization.**

Generate the stereo camera files using Export stereo camera files. A new window will appear asking you to save the left camera, click Yes and write the name as indicated under Calibration in Section 2 - Data management – How to store data correctly. The naming system is similar to that described in Section 0 -

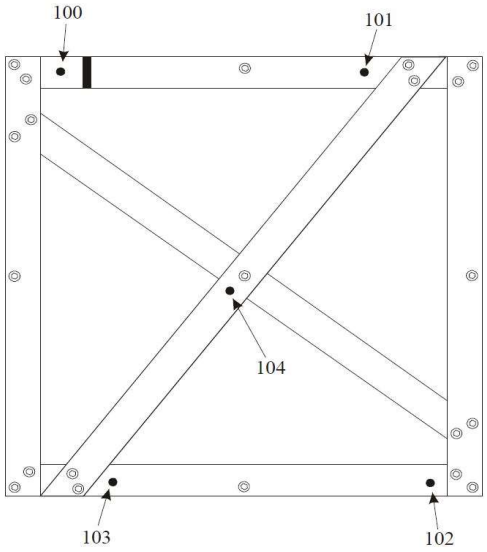


Figure 13 – Schematic representation of the front side of the calibration cube showing only the four resection points and its corresponding point numbers, as well as the bar indicating the location of the first resection point (100).

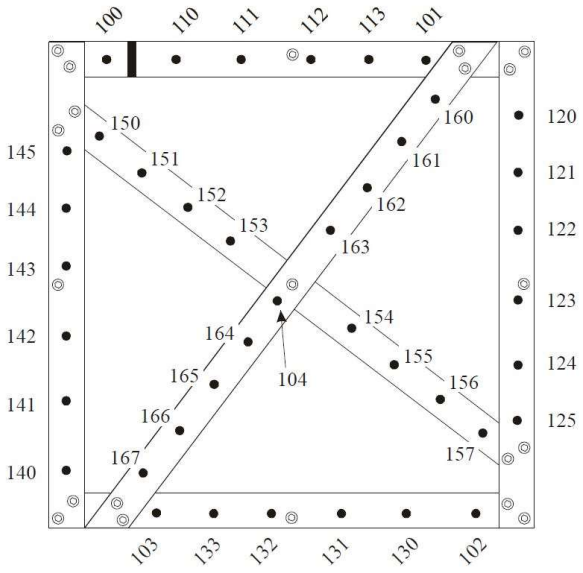


Figure 14 – Schematic representation of the front side of the calibration cube with the complete set of points and its corresponding point number.

- Once the four resection points have been identified in both video frames (left and right), you can identify the remaining object points (Figure 14) either manually or by using *centroiding* as explained in the previous point. After this process is completed, the image should be automatically resected.
  Remember, object points have to be identified in an ascending order based on the point number shown in Figure 14.

- Check point numbers identified in the CAL screen match those shown Figure 14. If a point number is incorrect, you can edit the number by right clicking the point. A new window will be displayed, here you can retype the correct the point number. You also have the option to delete a point from this window by clicking the *Delete* button.

Note that this process must be repeated for each cube position described in Appendix A – Calibration Cube Orientations (page 65) of the CAL User Manual (available in NAS1:\Common Resources\UsefulSoftware\StereoVideos\CAL). This means that you should have 20 images for each camera (i.e., 20 for the left camera and 20 for the right camera).
To ensure calibrations are accurate, it is helpful to have the *Data View* window open, as the *No. of points* section of this window will tell you the total number of points currently identified in your video. You need no less than 60 points before a calibration can be processed, but having more than 80 points increases the quality of the final calibration.

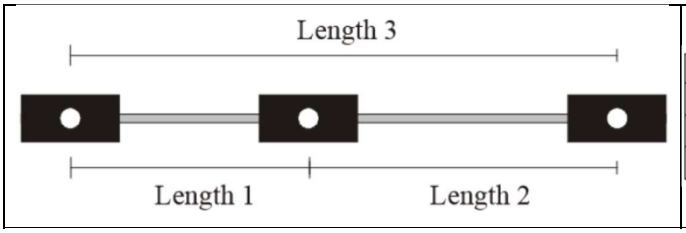
- Starting a new project, with the difference that an L or R will need to be included to specified the side of the camera file (e.g., **Calibration_SeaGis_P1L_20170427**). You will then be asked to save the right camera file.

4.1.6 Saving results

The simplest way to save the project and all associated data is to close CAL. The program will prompt you to save all unsaved data. If you are using a SeaGIS calibration cube, you don't need to save the object point (.PtsCAL) file.

4.2 Checking calibrations

To check the validity of the calibrations just processed, you can measure targets of known lengths in EventMeasure. Simply load the calibration video file as described in Section 5 – Analysing stereo-DOVs videos using the newly produced calibration files. Fast forward the video until you find the calibration distance bar (Figure 15). Measure the three different lengths described in Figure 15. If measurements are within ±10 mm of the actual distance bar measurements, then your calibration file is correct. If measurements are > 10 mm different than the actual measurements, then you will need to re-process your calibrations.



Length ID	Distance (mm)
Length 1	477.0
Length 2	780.5
Length 3	1257.5

Figure 15 – Schematic representation of the calibration distance bar (left) and measurements (right).

4.3 Recording calibrations completed in the log

Sometimes you may encounter that calibrations are used for more than one campaign, or that there is more than one calibration for one set in a given campaign. This may cause confusion when analysing videos, which will then lead to errors in measurements taken in stereo-videos.

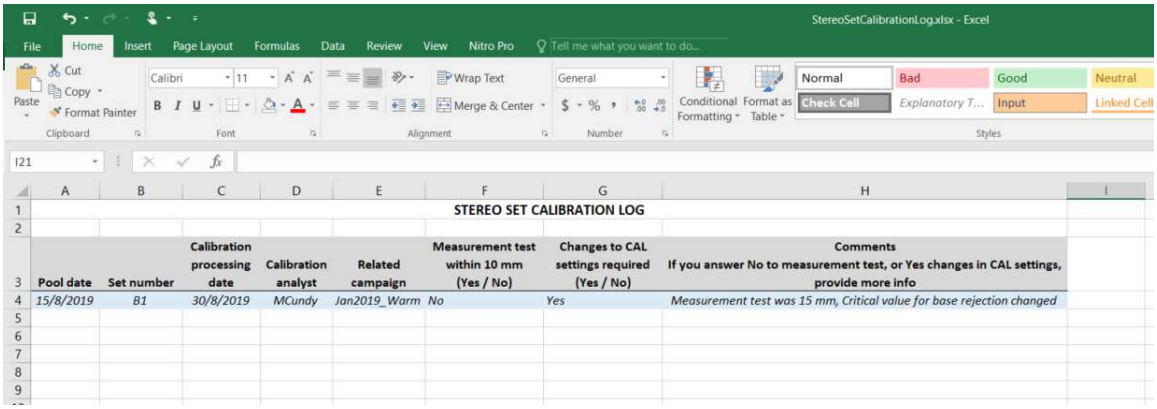
To avoid any errors in the future, you will record all calibrations you complete on the **StereoSetCalibrationLog** spreadsheet (Figure 16), which is available at NAS1:\Common Resources\Projects\SHARK SURVEYS. You will need to complete ALL columns in the log after you have finished processing and testing calibrations for a set. Note that if the

measurement test did not meet the 10 mm threshold, or if you changed any CAL settings, you will need to provide more information under the *Comments* column.

4.4 Troubleshooting for CAL

There are four or more exclusions in the stereo-constraints. Poor synchronisation and image pairing is the primary reason for rejections. Check the accuracy of the video synchronisation before adjusting any thresholds.

If synchronisation does not fix the problem, then the thresholds for exclusion may need to be increased. Increase values for either *Critical value for base rejection* or *Critical value for orientation rejection* under Stereo constraints by clicking on *Adjustment -> Adjustment Settings*. Once increased, re-estimate the constraints. See the Adjustment section of CAL User Manual (page 40) for more information on values that can be used. The CAL manual is available from NAS1:\Common Resources\UsefulSoftware\StereoVideos\CAL



STEREO SET CALIBRATION LOG

Pool date	Set number	Calibration processing date	Calibration analyst	Related campaign	Measurement test within 10 mm (Yes / No)	Changes to CAL settings required (Yes / No)	Comments If you answer No to measurement test, or Yes changes in CAL settings, provide more info
15/8/2019	B1	30/8/2019	MCundy	Jan2019_Warm	No	Yes	Measurement test was 15 mm, Critical value for base rejection changed

Figure 16 – Stereo set calibration log must be completed after completing calibration process.

If a point is measured and the automatically assigned point number is incorrect.

- The number can be manually adjusted by right clicking on the point. This displays a window that allows the point number to be deleted and adjusted.

The program doesn't accept the measurements even when checked many times.

- Use *Adjustment -> Adjustment settings* to change any parameters related to the computation of the bundle adjustment. For more details on how to fix more complicated problems, read the **Adjustment** section from page 39 in the CAL User Manual found in NAS1:\Common Resources\UsefulSoftware\StereoVideos\CAL.

5 Analysing stereo-DOVs videos

Ensure the folder structure described in Section 2 - Data management – How to store data correctly has been correctly created prior to attempting the analysis of any videos. Additionally, you will also need to have access to the correct calibration files and videos for the campaign you are about to analyse.

All stereo-video analysis is done in EventMeasure (EM), which is a program used for recording biological information related to marine animals and habitat surveyed using still images or

videos. If stereo-video sets are used in the survey, then EM allows us to measure the length of individuals, as well as their distance from the cameras with a high level of precision. EM is flexible as it allows us to create our own attribute files, which means we can record data relevant to our particular project. Additionally, we can also define the species that are relevant to our area of study.

EventMeasure produces two files while the analysis is being done with the extensions **.EMObs** and **.EMObs_AUTO**, both of which store information about fish identifications and measurements, as well as any additional information set in the attribute file. EM can also produce text files (.txt) as outputs containing summaries of the information contained in the EMObs files that can be imported into other programs for further analysis.

5.1 Loading videos into EventMeasure

- Open the **DOVsProgressSheet** that has been shared in Google Drive. In the 'prog1-Interest-School-Gring' sheet, check if you will be analysing converted or unconverted videos (Figure 11). These videos are dealt with slightly different in EM as described in the following subsections.
- Get a USB key from your Supervisor and connect device to a port in your computer. Open EM.
- It is recommended that you turn the sound off by clicking the *Sound* button, the X means the sound is off.
- Before uploading videos, ensure the *Lock* box is unchecked to stop EM trying to maintain synchronisation while the videos are loaded.

5.1.1 Converted videos

- Create a new measurement file by clicking on *Measurement -> New measurement file*. You will be prompted to save the current file, click *Cancel*.
- Select the folder containing the converted videos you need to analyse by clicking on *Picture -> Set picture directory* in the tools bar. Remember, all converted videos that are part of the analysis should be in this same folder. The directory path should follow the guidelines described in Section 2, a correct directory path should look like this: **\\Jan2018\Darwin\DOVS\Sites\ArcoArenal_B2_20180126\ConvertedVideos**
- Upload the LEFT video first, by clicking *Picture -> Load picture*. In the pop-up window choose the LEFT video. Remember the converted videos should be in .avi format and its name should include an **L**, for example **ArcoArenal_20180120_B2L.avi**.
- The pop up window *Define movie sequence* will appear, check the video name is correct. If the window does not appear, go to *Picture -> Define movie sequence*. If no videos are included in the window, you can add them by clicking the *Add Files* button.
- Upload the RIGHT video in *Stereo -> Picture -> Load Picture.* Select the RIGHT video in the pop-window. Remember converted videos are in .avi format and an **R** defines it as a RIGHT video, for example **ArcoArenal_20180120_B2R.avi**.
  Note: The RIGHT and LEFT videos should have the same site name and date in their names.
- Check the video name is correct in the *Define movie sequence* pop-up window. If the window does not appear, go to *Stereo -> Picture -> Define movie sequence*. If no videos are included in the window, you can add them by clicking the *Add Files* button.

Once both videos (left and right) are loaded into EM, you are ready to synchronise them. This means that both videos should be locked in such a way that they both show the exact same point in time. You can use the built-in player to do this.

- To synchronise the videos, find the frame with the applause sequence in both videos. You can slow down the videos using the *Rate* box above the player or use the left and right arrow keys to advance one frame at a time until you find the frame in both videos, where they show the exact same point in time. Once you are happy with the frames, lock them by ticking the *Lock* box. Note that if you are using the movie player, you must click *Close player and update position* before you can see *Lock* tick box.
- Save the synchronisation frame by adding a 3D point and call it *Sync*.

5.1.2 Unconverted videos

Unconverted videos are often not merged together, which means you will have multiple files for the RIGHT and/or LEFT videos as explained in Section 3.3 - Load and convert video files. Their names will include the order in which each files appear in the video sequence.

Remember all LEFT and RIGHT videos must be located in the same folder before you attempt to analyse them in EM.

- Select the folder containing the converted videos you need to analyse by clicking on *Picture -> Set picture directory* in the tools bar. Remember, all converted videos that are part of the analysis should be in this same folder. The directory path should follow the guidelines described in Section 2, a correct directory path should look like this: **\\Jan2018\Darwin\DOVS\Sites\ArcoArenal_B2_20180126\ConvertedVideos**
- The pop up window *Define movie sequence* will appear, check the name of the first video is correct. If the window does not appear, go to *Picture -> Define movie sequence*. Upload the remaining LEFT videos in sequential order by clicking the *Add Files* button (Figure 17).
- Upload the RIGHT video in *Stereo -> Picture -> Load Picture.* Select the first RIGHT video of the sequence in the pop-window. The video should be named something similar to **ArcoArenal_20180120_B2R_1.avi**.
  Note: The RIGHT and LEFT videos should have the same site name and date in their names.
- Check the video name is correct in the *Define movie sequence* pop-up window. If the window does not appear, go to *Stereo -> Picture -> Define movie sequence*. Upload the remaining RIGHT videos in sequential order by clicking the *Add Files* button.

Once both videos (left and right) are loaded into EM, you are ready to synchronise them. This means that both videos should be locked in such a way that they both show the exact same point in time. You can use the built-in player to do this.

- To synchronise the videos, find the frame with the applause sequence in both videos. You can slow down the videos using the *Rate* box above the player or use the left and right arrow keys to advance one frame at a time until you find the frame in both videos, where they show the exact same point in time. Once you are happy with the frames, lock them by ticking the *Lock* box. Note that if you are using the movie player, you must click *Close player and update position* before you can see *Lock* tick box.
- Save the synchronisation frame by adding a 3D point and call it *Sync*.

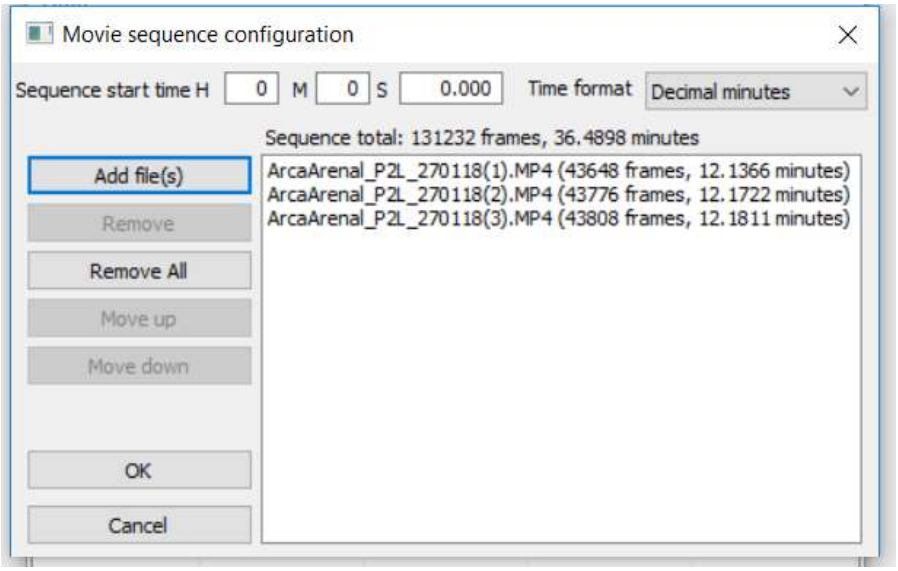


Figure 17 – *Movie sequence configuration* window in EventMeasure showing all video files making up one complete LEFT movie. Note that files are listed sequentially from 1 to 3 (top to bottom). The number of frames and total duration are also included in brackets next to each video file.

NOTE: If unconverted files are not automatically uploaded to the EM player once the first one finishes, you may need to manually upload each file making up the full video. Remember that because cameras were turned on at different times, the left and right files may not end at the same time. In order to keep the synchronisation of the video, you will need to follow the following steps every time a new video needs to be loaded:

- Ensure the *Lock* box remains ticked.
- Make note total number of frames of the video you are currently viewing in EM. You can access this information from the *Movie sequence configuration* window as described in previous steps (Figure 17).
- Fast forward the current video to its last frame by right clicking over the video in question and clicking on *Jump to frame*. A *Input Dialog* pop up window will appear, enter the total number of frames for the video and click *OK* (Figure 18). EM will now show the final frame of that video.
- Upload the next unconverted movie file by using either the *Picture* or *Stereo* menus for the left and right videos respectively as previously explained. Add a 3D point and name it, *Sync 2*.
- Repeat these steps until all video files making up in the LEFT and RIGHT videos are uploaded and stitched together with the various 3D Sync points. Note that the number of the 3D point name created to link the videos should be increased sequentially by one.

Note that video synchronisation is kept because the last frame of a file is the same as the first frame of the next file. You will need to follow the above steps every time a video is not automatically loaded into EM.

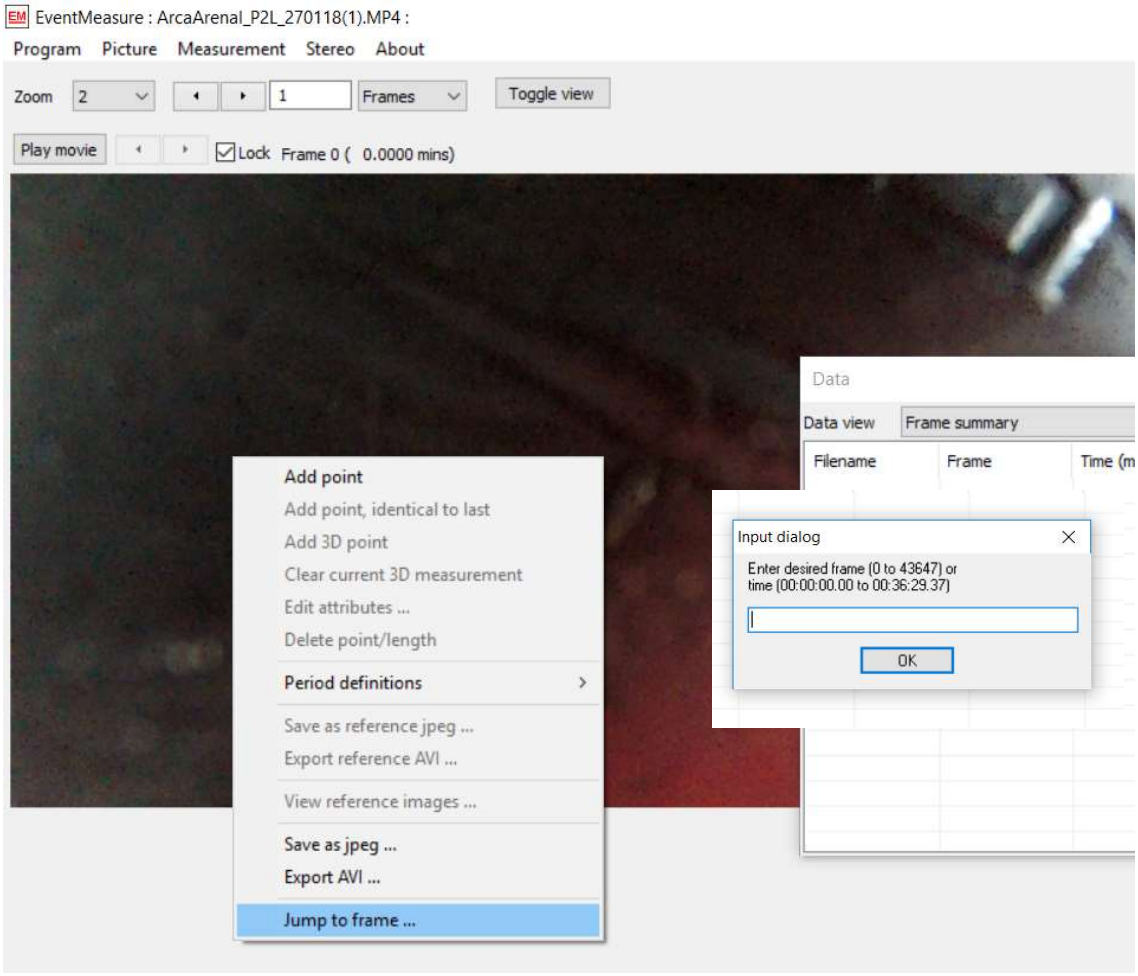


Figure 18 – Example of how to fast forward a video (left video shown) using the right click menu.

5.2 Editing information fields and the species list

- Once both videos (left and right) have been uploaded into EM, you need to input some metadata using *Information Fields*. Go to *Measurement -> Information fields -> Edit field values*.
- A new window will appear (Figure 19) with the four fields described below. To edit the content of a field, simply double click the *Data* column. Click the *Close dialog* button when you are done.
    - **OpCode**, which is the site where the video was collected. This field should also include the stereo-video set used and the date the video was collected. This should match the name of the folder containing the videos currently being analysed, for example **Derrumbe_P2_20170508**.
    - **TapeReader**, which refers to the video analyst. Here you need to write your name (e.g., AnaMoya).
    - **Depth** is the actual depth in meters at which the video was collected. You will find this information in the **FieldDB** tab of the **DOVsProgressSheet**.
    - **Comment**, which should be used to report if you are working with unconverted videos or anything else you think is relevant.You can also report any problems you may have encountered while analysing the videos.

If you would like to add additional comments, the *Information fields* can be edited at any point during the video analysis process.

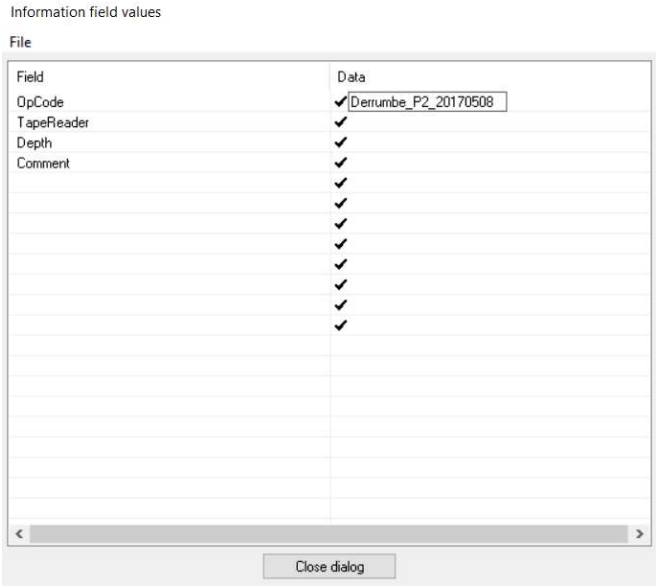


Figure 19 – *Information field values* pop-up window. To edit the content of a field, simply double click the *Data* column.

- We have developed a species list, which include the species that are found in Darwin and Wolf islands. A copy of this list should have been included when the folder structure for the current campaign was created (see Figure 6 for information on the location of this file). Alternatively, a copy of the updated list can be found in the NAS1 server under Common resources. To add the species list to your current project, go to *Measurement -> Attributes -> Edit/load species files*.
- A *Species and attribute files* pop-up window will appear. Double click in the blank space under the *Current File* column next to *Species file*. This will allow you to choose the folder containing the species list text file. Click *Open* to close the window and the file directory now appears next to *Species file* (Figure 20). Click the *Close dialog* button when you are done.

5.3 Loading calibration files

All calibration files (extension .Cam) needed to analyse the videos linked to the campaign you are currently analysing can be found under the **Calibration** folder (see Section 2.1.1 - Calibration folder). The file directory containing the relevant files should look similar to: **\\Jan2018\Calibration\CAL_Files**. Remember, you must have two calibration files (left and right) for each pair of videos analysed.

- First upload the LEFT calibration file, go to *Stereo -> Cameras -> Left -> Load camera file*. Locate the LEFT calibration files in the pop-up window and click *Open*. Remember that the camera file must have an L in its name (for left video) and must also match the video set camera in the OpCode. For example, if the OpCode for your video is **Derrumbe_P2_20170508**, your left calibration file should be called **Calibration_SeaGis_P2L_20170430.Cam**. Note the date of the calibration must be about two weeks before or after the deployment date in the OpCode.

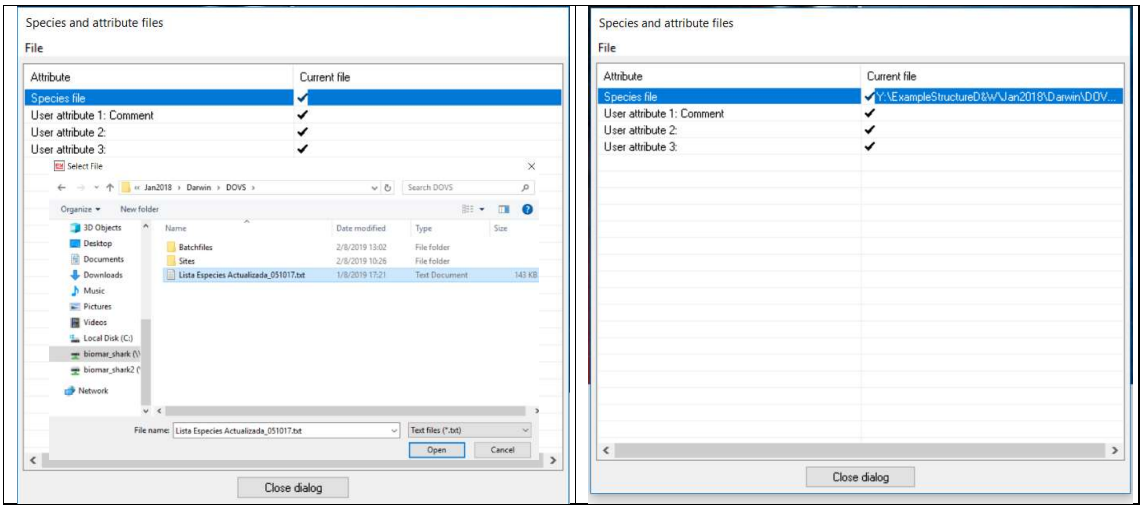


Figure 20 – *Species and attribute files* editing sequence. To edit the content of a field, simply double click the *Current file* column.

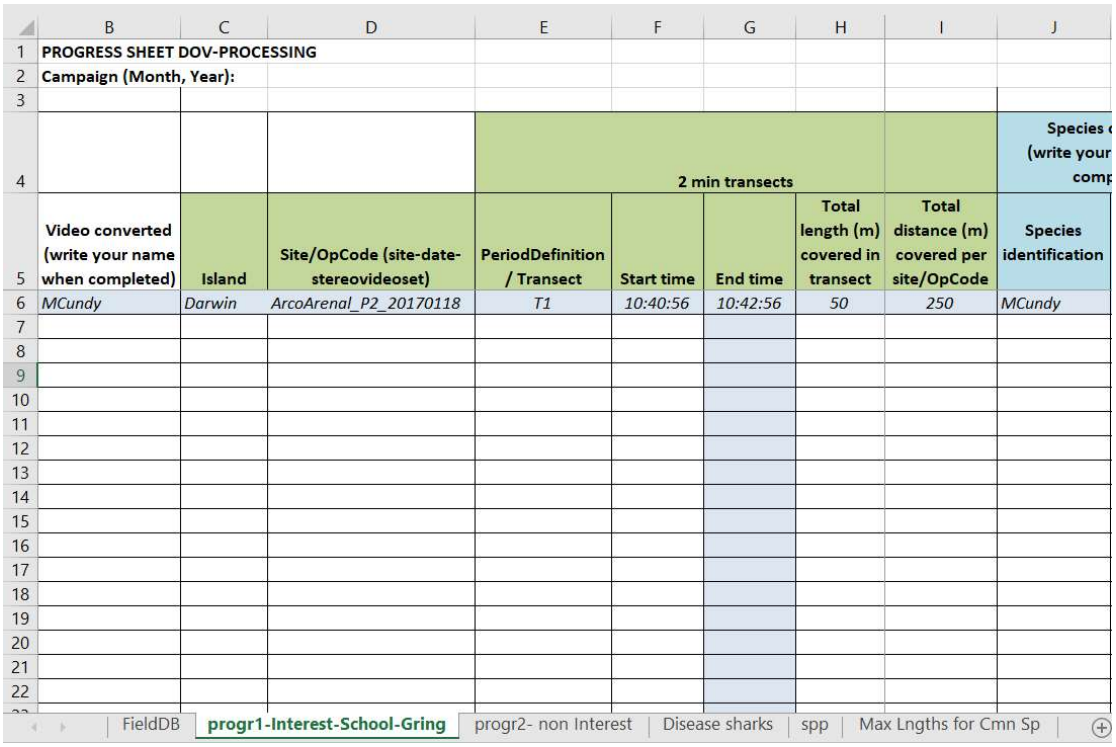
- Upload the RIGHT calibration file, go to *Stereo -> Cameras -> Right -> Load camera file*. Locate the RIGHT calibration files in the pop-up window and click *Open*. Following the above example, the calibration file should be named **Calibration_SeaGis_P2R_20170430.Cam**. Note the left and right calibrations must have been completed on the same date.

You can check all settings in your current project by clicking on *Program -> Current settings*. Ensure all files are related to the same campaign you are about to analyse.

5.4 Saving an EMObs file for current analysis

Once you have completed all the steps described above (i.e., loading videos and calibrations, synchronising videos, writing metadata and uploading the species list), you will have to save your progress so far. This will create a EMObs file, which will contain information about all files related to the analysis, and it will also store information about identification of individual fish and any measurements you make. Remember, EMObs will be saved under the specific site folder being analysed and it should have a similar name to the videos being analysed as described in Section 2.1.2.1 - DOVS folder. The directory and file name should be similar to **\\Jan2018\Darwin\DOVS\Sites\ArcoArenal_B2_20180126\ArcoArenal_20180120_B2.EMObs**.

- To save your progress, go to *Measurement -> Save*. Ensure you save the EMObs in the correct folder and correct name.
- Open the **DOVsProgressSheet** for the campaign you are currently analysing (Figure 21). Select the **progr1-Interest-School-Gring** sheet and complete the **Island** and **Site/OpCode** columns.



	B	C	D	E	F	G	H	I	J
1	PROGRESS SHEET DOV-PROCESSING								
2	Campaign (Month, Year):								
3									
4				2 min transects					Species (write your comp
5	Video converted (write your name when completed)	Island	Site/OpCode (site-date-stereovideoset)	PeriodDefinition / Transect	Start time	End time	Total length (m) covered in transect	Total distance (m) covered per site/OpCode	Species identification
6	*MCundy*	*Darwin*	*ArcoArenal_P2_20170118*	*T1*	*10:40:56*	*10:42:56*	*50*	*250*	*MCundy*
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									

FieldDB | progr1-Interest-School-Gring | progr2- non Interest | Disease sharks | spp | Max Lngths for Cmn Sp

Figure 21 – Screenshot of *DOVs Progress Sheet* section related to the definition of video analysis videos. Note that the first row under the column name (highlighted in blue) contains an example of how the datasheet should be correctly filled.

5.5 Setting up video analysis periods

Although stereo-DOV videos are collected while diving a single 20-25 min transect, we do not analyse the video in its entirety. Instead, we analyse a total of eight (8) 2-minute transects from the beginning of the survey (marked by the cameras going up and down while in the water), each of which is separated by a 15-second gap. To mark the beginning and end of the 2-minute transects, we use the *Period definition* function in EM. Instructions on how to set up periods are described below.

Additionally, you need to open the **DOVsProgressSheet** for the campaign you are currently analysing (Figure 21). Ensure the **progr1-Interest-School-Gring** sheet is active before continuing.

1. Find the beginning of the survey, by locating the frame(s) when the camera set goes up and down in the water column. Note the time when cameras begin recording parallel to the substrate. The first period will begin when the decimal seconds in the video are .0000, for example, *00:15:**40.0000***.
2. Enter transects 1 to 8 in column E, PeriodDefinition / Transect, of the **DOVsProgressSheet** (Figure 21). Remember, enter one transect per row and label them T1 to T8. In column F, Start time, of row T1, write down the time when your video transect started (see previous step). This will automatically calculate the start and end time for the eight (8) transects. Each transect should last 2 minutes and there should be a 15 second gap between transects.

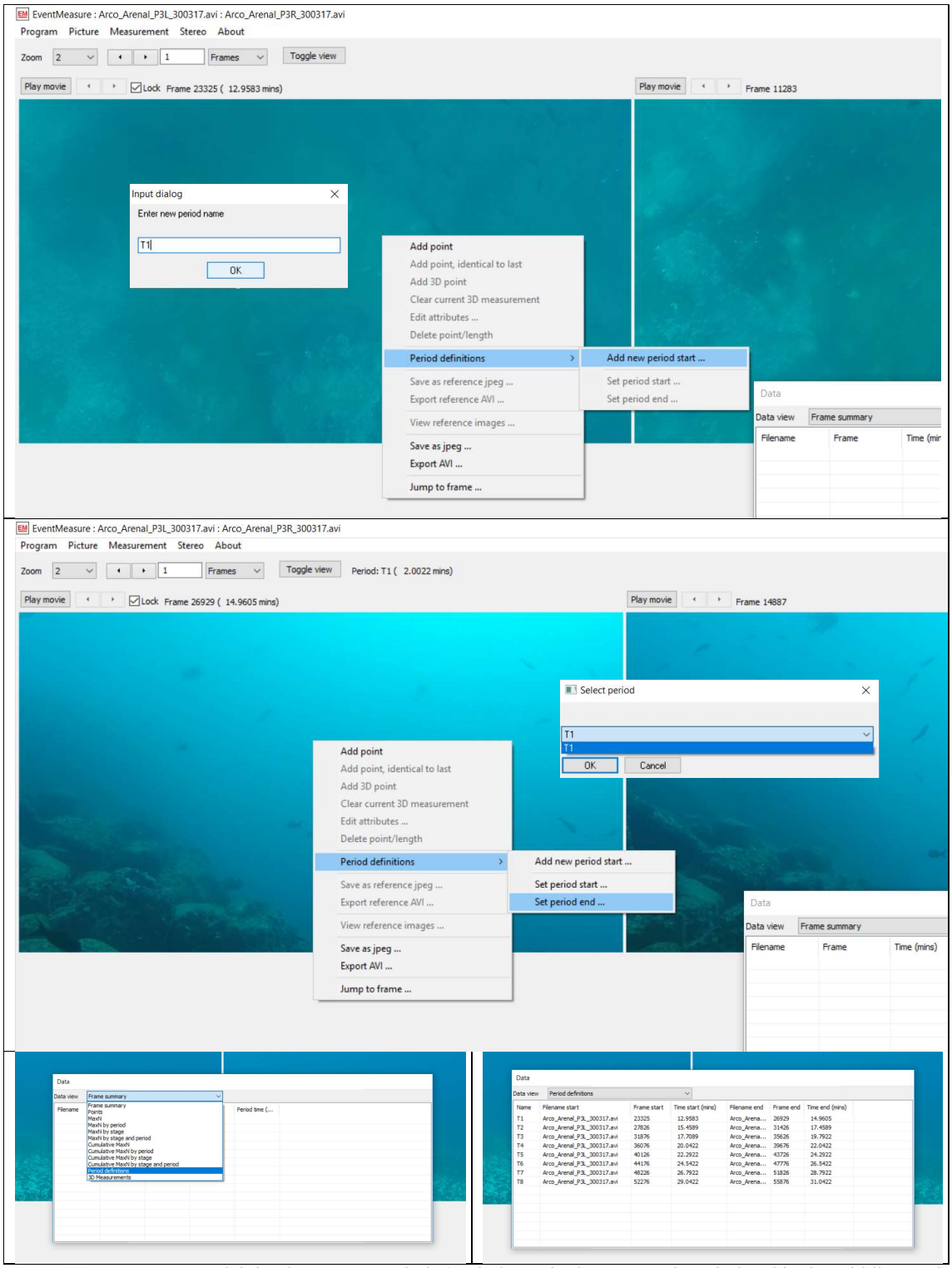


Figure 22 – Sequence explaining how to set periods (period start in the top panel, period end in the middle panel) during video analysis. The menu appears when right clicking the left video. The bottom panel shows how to check all defined periods using the *Data* window.

3. Remember to complete all other relevant columns before moving on to the next step.
4. In EM, if necessary, fast forward the video to the Start Time of T1 using the *Jump to Frame* right click option (Figure 18). Once you are on the right frame, right click on the left video

and click on *Period definition -> Add new period start*. In the *Input dialog* box, write down the transect name, T1 in this case (Figure 22).

5. Fast forward the left video (Figure 18) to the End time for T1 calculated in the **DOVsProgressSheet** (column G, Figure 21). Once you are on the right frame, right click on the left video panel and click on *Period definition -> Set period end*. In the *Select period* window, select the period you are about to end, in this case T1 and click *Ok* (Figure 22).
6. Repeat steps 4 and 5 for each transect using the Start and End time columns (columns F and G, Figure 21) of the **DOVsProgressSheet**.
7. When you set the eight periods, one for each transect in the **DOVsProgressSheet**, you can check periods have been correctly defined using the *Data* window (Figure 22). Simply choose *Period definitions* in the dropdown list and a list of all periods with their starting and end times and frames will appear. Ensure periods are 2 minutes long and that there is a 15 second gap in between each period. Additionally, if you double click any item in this list, it will direct you to the beginning of that period.
8. **Save your work so far (Section 5.4 - Saving an EMObs file for current analysis).**

Once periods have been defined in EM (there should 8 in total, one per transect), the videos are ready to be analysed. Remember, each video must be analysed by at least two people. Analyst 1 will go through all the transects identifying each individual fish to species level whenever possible. Analyst 1 will also count all individuals of the species they have identified. Analyst 2 will do quality control as in explained in Section 5.12 - Quality control and if the test is passed, then they will move on to measuring all the fish identified by Analyst 1.

5.6 Useful sources to aid in fish identification

To ensure identification is consistent of fish species is consistent over time, we will use scientific names only. The accepted nomenclatures will be the same as those used in World Register of Marine Species (WoRMS). The species list is already set up to reflect this, do NOT change the spelling of the nomenclatures. If you spot an error in the spelling of names, speak to your Supervisor.

To facilitate fish identification, you will have access to the following resources:

- Shorefishes of the Eastern Pacific guide by the Smithsonian Tropical Research Institute available online in English and Spanish: https://biogeodb.stri.si.edu/sftep/en/pages
- Reef fish identification guide for Galapagos por Paul Humann & Ned Deloach. Two copies are kept in the office.
- FishBase
- WoRMS

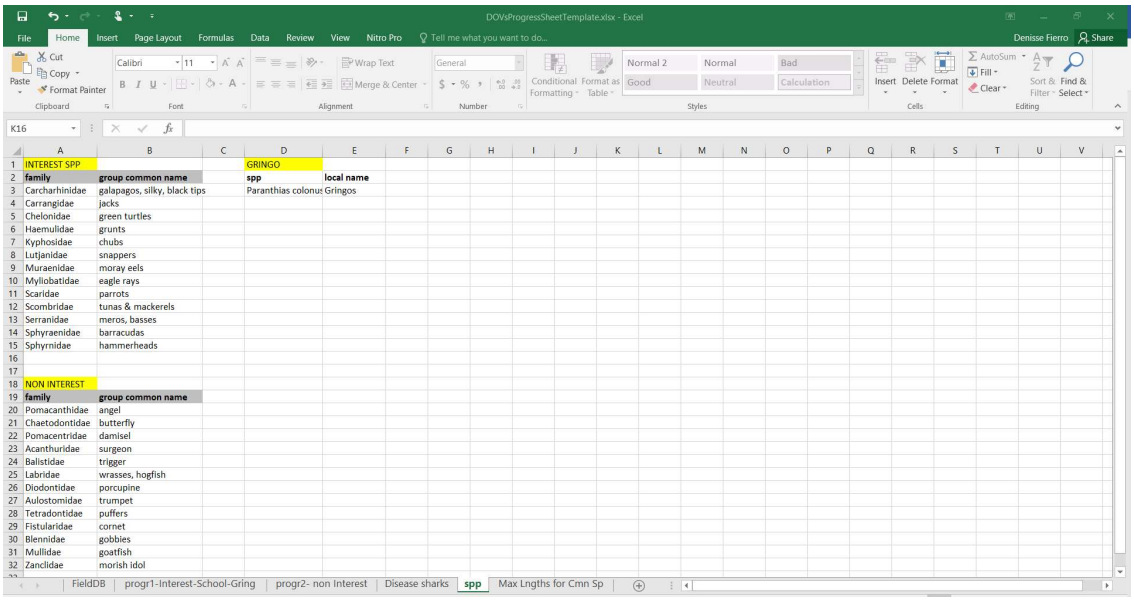
5.7 Species of interest – large carnivorous fish

Remember fish identification and counts must NOT be performed by the same person measuring the fish. Refer to Section 5.12 - Quality control for more information.

The species of interest for this project are large carnivorous fish. Information about the Families included in this group can be found in the *spp* tab of the **DOVsProgressSheet** (Figure 23).

When you analyse a video, you will start by identifying individuals to species level if possible and count all individuals of that species. Once identification is completed, measurements will be taken by a second Analyst. Remember, you will need to write down your name in the column

for *Species identification* or *Measurements taken* in the **DOVsProgressSheet** when you complete any of these tasks.



	A	B	C	D	E
1	INTEREST SPP			GRINGO	
2	family	group common name		spp	local name
3	Carcharhinidae	galapagos, silky, black tips		Paranthias colonus	Gringos
4	Carrangidae	jacks			
5	Chelonidae	green turtles			
6	Haemulidae	grunts			
7	Kyphosidae	chubs			
8	Lutjanidae	snappers			
9	Muraenidae	moray eels			
10	Myliobatidae	eagle rays			
11	Scaridae	parrots			
12	Scombridae	tunas & mackerels			
13	Serranidae	meros, basses			
14	Sphyraenidae	barracudas			
15	Sphyrnidae	hammerheads			
16					
17					
18	NON INTEREST				
19	family	group common name			
20	Pomacanthidae	angel			
21	Chaetodontidae	butterfly			
22	Pomacentridae	damisel			
23	Acanthuridae	surgeon			
24	Balistidae	trigger			
25	Labridae	wrasses, hogfish			
26	Diodontidae	porcupine			
27	Aulostomidae	trumpet			
28	Tetradontidae	puffers			
29	Fistularidae	cornet			
30	Blennidae	gobbies			
31	Mullidae	goatfish			
32	Zanclidae	morish idol			

Figure 23 – Screenshot of the **spp** tab of the ***DOVs Progress Sheet***, which contains information on families of interest and non-interest for this study.

Species identification and counts are completed three times in one video. First, you will only focus on <u>sharks ONLY</u>, the second time you will concentrate on species of interest (other than sharks), and finally you will look for species of no interest.

5.7.1 Identifying and counting individuals of interest

- Go to the beginning of transect 1, T1, by either double clicking it on the *Data* window (bottom panel Figure 22), or by jumping to the start time of T1 using the *Jump to frame* option (Figure 18).
- Identify ALL individuals belonging to the families of interest (*spp* tab of the **DOVsProgressSheet,** Figure 23) you see in the video by following these steps:
    - On the left video, right click on top of the individual being identified. Click *Add point* and the *Attributes – Point* window will appear.
        - Using the dropdown lists, you will ideally identify individuals to species level (Figure 24). If it is not possible, only fill in the boxes you can confidently complete (Genus or Family).
          <u>NOTE</u>: You will need to at least select a Family from the dropdown list to record a point. If you know the Genus, select from the list, otherwise leave it blank. If you cannot identify individuals to species, write sp1 under the Species field. Every time that you find an individual of a <u>new unknown species</u> of a Family/Genus previously identified, write sp2, sp3, sp4 and so on under Species.
        - Under *Stage*, select AD for adult, F for female, J for juvenile, M for male, or leave blank if you are unsure.
        - In *Activity* select the action that best describes what the animal is doing from the dropdown list.

- In *Comment* you can include any additional information you think is relevant. You will use this field if you are unsure of the species by writing '*Check ID*'.

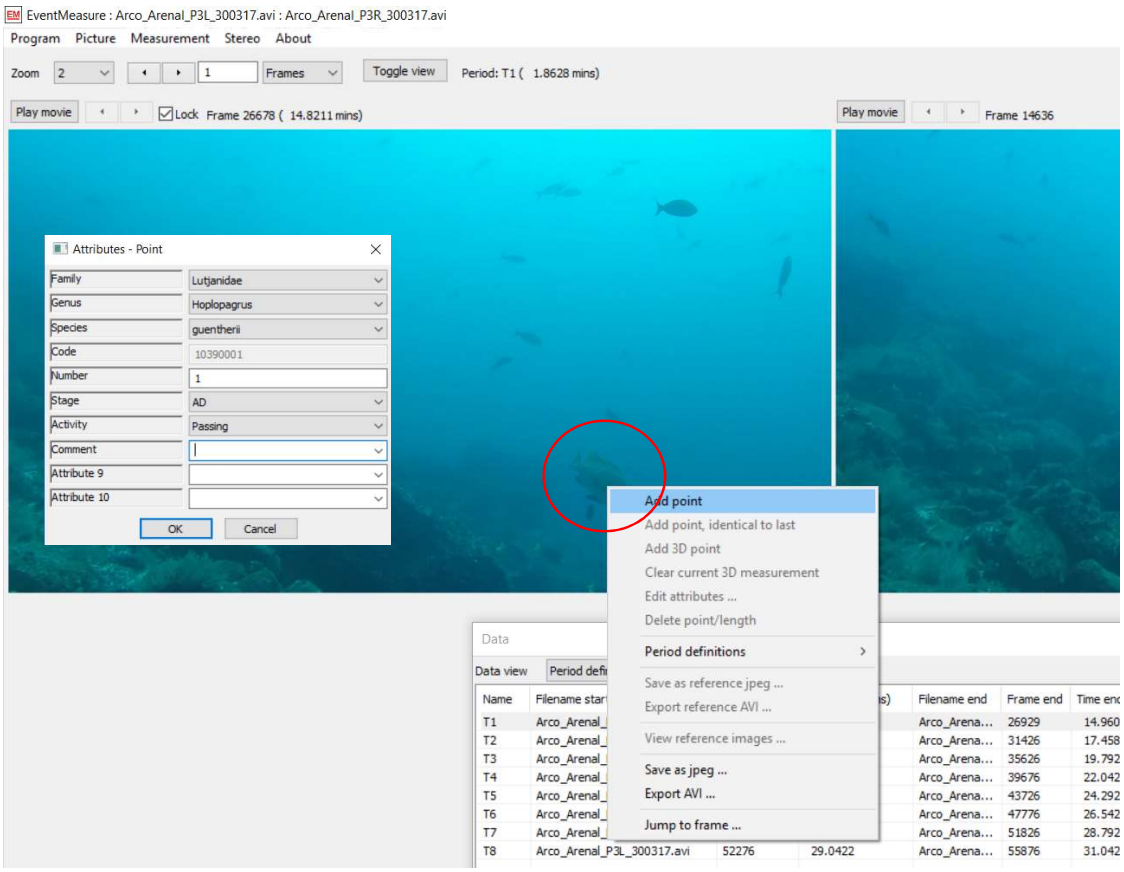


Figure 24 – Sequence to identify an individual fish in EM. In this example, a *Hoplopagrus guentheri* (red circle) is being identified. Right click on the individual, click on *Add point* and a blank *Attributes – Point* window will appear. The example above shows the *Attributes – Point* window correctly filled in.

- If you see a hammerhead shark with signs of skin disease (white spots , Figure 3), fill in all columns in the *Disease sharks* tab in the **DOVsProgressSheet.**
- If you encounter 20 or more individuals of the same species in the same vicinity forming a cohesive group (often moving in unison), we consider them to be a school (Figure 27). You will count all them as explained above and you will have to record this information under the '<u>Schools of fish</u>' section in the *progr1-Interest-School-Gring* tab in the **DOVsProgressSheet.** If you encounter more than one school in one transect, simply enter a second row with this information (Figure 25).
- Once you reach the end of the first period, write down your name in the *Species identification* column of the **DOVsProgressSheet.**
- Finally, save your progress so far by clicking on *Measurement -> Save*.
- Fast forward to T2 and repeat the process above until you reach T8. Ensure you record your name in the **DOVsProgressSheet** every time you finish analysing a transect.

<u>Note</u>: Only individuals that meet the following requirements can be included in the counts:

- The same individual MUST appear in both cameras (left and right).
- The individual MUST appear for the first time within the period (e.g., T1 to T8). If the individual appears between periods (15 second gap), it cannot be included.

				2 min transects				Species of interest (write your name when completed)		Large schools of fish (over 20 individuals of the same species) Species of interest - if < 100 ind - 100% measured, if > 100 ind - 50% measured Non interest species - if < 100 ind - 50% measured, > 100 ind - 25% measured				
Video converted (write your name when completed)	Island	Site/OpCode (site-date-stereovideoset)	PeriodDefinition / Transect	Start time	End time	Total length (m) covered in transect	Total distance (m) covered per site/OpCode	Species identification	Measurements taken	Family	Species	total number of individuals in transect	Number of individuals to be measured - see rules above	Actual individuals measured
MCundy	Darwin	ArcoArenal_P2_20170118	T1	10:40:56	10:42:56	50	250	MCundy	DFierroArcos	Balistidae	Balistes polylepis	52	26	25
MCundy	Darwin	ArcoArenal_P2_20170118	T1	10:40:56	10:42:56	50	250	MCundy	DFierroArcos	Carangidae	Caranx caballus	120	60	60
													0	
													0	
													0	
													0	
													0	

Figure 25 – Screenshot of the progr1-Interest-School-Gring *tab in the* ***DOVsProgressSheet*** showing how to correctly record more than one school found in the same transect (T1 in this case). Note that the 2-min transect and species of interest columns (red box) contain the exact same information because it refers to the same transect.

5.7.2 Measuring individuals of interest

Load videos, calibration files, species list and edit information fields following the instructions given in previous section of this protocol. Although if you load the EMObs file containing the identification and counts of fish you may not have to do this again. Ensure videos are synchronised correctly and that you have locked both videos to keep synchronisation throughout the duration of the video. Once this has been done, you are ready to start measuring individuals.

- Using the *Data* window, select *Points* from the dropdown list. This will show you all the individuals identified in the video (Figure 26). This window will also show the period these individuals were identified in. Double click a row and this will fast forward the video to the frame that individual was identified in.
- Ensure you also check the '<u>Schools of fish</u>' section in the *progr1-Interest-School-Gring* tab in the **DOVsProgressSheet** (Figure 25). If any schools have been identified for the transect you are doing measurements for, you will only need to measure subset of all individuals. Check Section 5.8 - Large schools of fish for more information on how to deal with these.
- Check that the identification information (Family, Genus and Species) actually matches the fish you are about to measure. If it does not match, make sure you correct the mistake and put a comment '*Species corrected*'. If a fish has been marked with '*Check ID*', check if you are able to identify it, otherwise seek help from your Supervisor in trying to ID the fish.
- Before you start measuring individuals, remember that a fish must appear on the two videos (left and right) to be measured. To get more accurate measurements try to meet the following criteria:
    - Fish are close to the centre of the camera's field of view
    - Fish are parallel to the camera
    - Fish are close to the camera set

  Do not hesitate to go forwards or backwards a few frames until you find the best possible position for that particular fish to be measured. Do not worry if you measure a fish when it is not within a period. This rule only applies to identifications and counts. **Note:** If you move frames, ensure you are measuring the correct fish.
- We work with fork length (FL), this means the length from the fish snout to where the tail bifurcates (or the middle of the tail if the fish has one lobe). To measure a fish, do the following:
    - Choose a video (either left or right), click where the snout of the fish begins. A red crosshair will appear in the video you just clicked and an epipolar line (red dotted line advising of possible location of the fish in the opposite video) will appear in the other video. Do not hesitate to zoom into the fish if you need to.
    - On the same video, click where the tail bifurcates (or the middle of the tail if the fish has one lobe). Another red crosshair will appear and the epipolar line will recalibrate.

- On the opposite video do the same. First, mark the snout and then the fork.

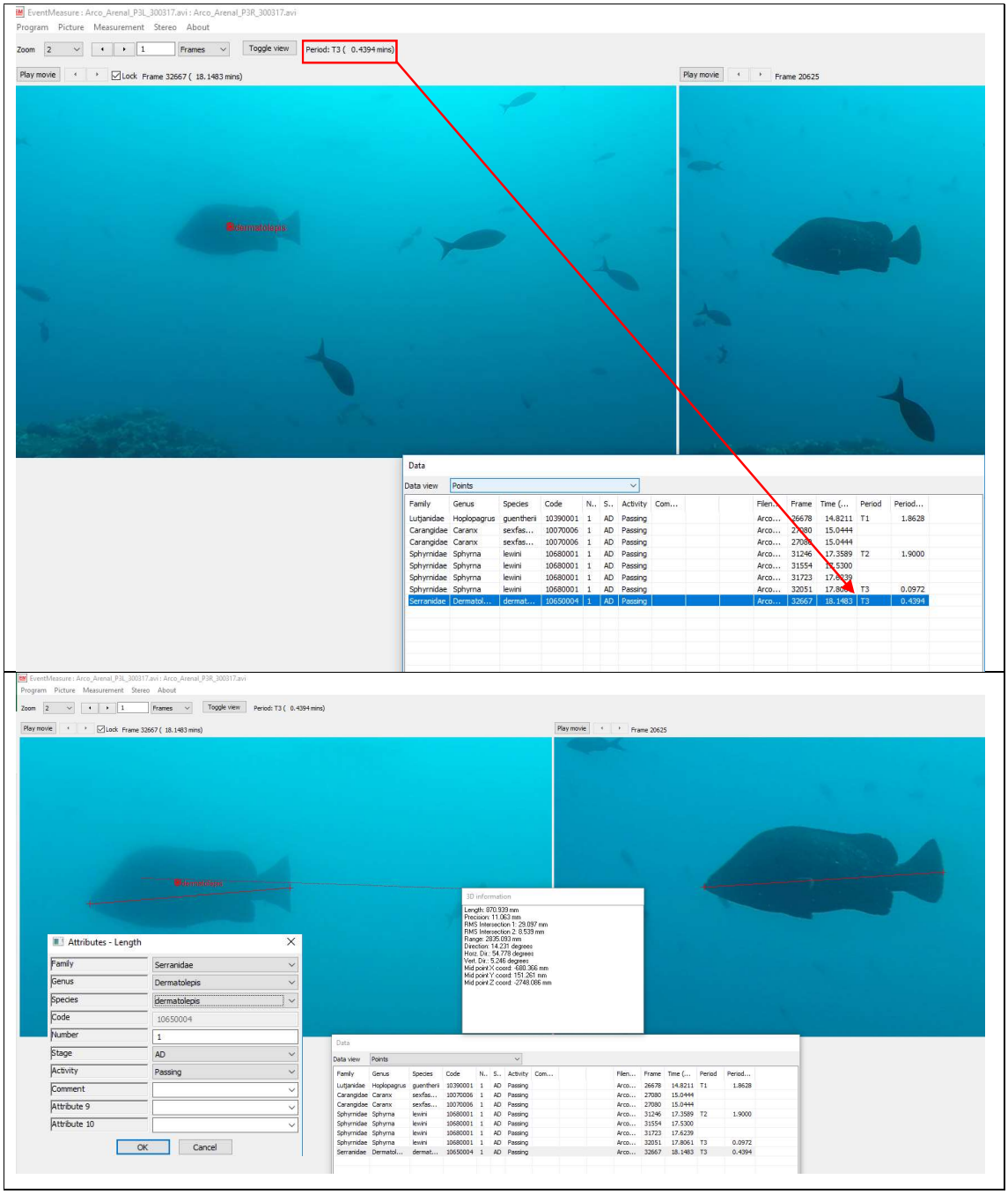


Figure 26 – Top panel: Using the *Data* window (Data View: Points) to select individuals to be measured. Double clicking a row will fast forward the video to the location of the fish. Bottom panel: Individual being measured. Note that points have been put in the same relative places in both videos (left and right). When four points are given (two in each video), the *3D information* window will pop up providing information about the measurement just taken.

- When measuring is done, a *3D information* window will pop up with information about the measurement you just made. Check the following:
    - Length in mm. Check that the length is reasonable for the species you are measuring. Refer to the maximum sizes in the *Max Lngths for Cmm Sp* tab in the **DOVsProgressSheet**.

  - Check Precision value is < 10 % of the length measurement. For example, if Length = 882.119 mm and Precision = 11.224 mm, we see this condition has been met, as 10% of length is 88.2119 mm.
  - Check RMS values (both 1 and 2) are as close to 20 as possible, and always under 100.
  - If either Precision or RMS conditions are not met, reject the measurement and measure the individual again.
  - If both Precision and RMS conditions are met, accept the measurement by clicking *OK* in the *Attributes – Length* window (Figure 26).
- When you are done measuring all individuals identified in a transect, make sure to write down your name under the *Measurements taken* column in the **DOVsProgressSheet.**
- Finally, save your progress so far by clicking on *Measurement -> Save*.

5.8 Large schools of fish (20 individuals or more)

If while identifying fish, you encounter 20 or more individuals of the same species in the same vicinity forming a cohesive group (often moving in unison), we consider them to be a school (Figure 27). You must count all fish in that school, but only a subset is measured. As previously explained, this information is recorded under the 'Schools of fish' section in the *progr1-Interest-School-Gring* tab in the **DOVsProgressSheet** (Figure 25).

The number of individuals to be measured will depend on whether they belong to a Family importance to their project or not, and the total number of individuals making up the school. Note that this does not apply to Gringos (*Paranthias colonus*) as they are treated differently to any other species due to their high abundance. The rules to determine the number of individuals to be measured are as follows:

- Species belonging to Families of importance to the project
  - 100 individuals or less in school, 100% individuals to be measured
  - > 100 individuals school, 50% individuals to be measured
- Species that do NOT belong to Families of importance to the project
  - 100 individuals or less in school, 50% individuals to be measured
  - > 100 individuals school, 25% individuals to be measured

The total number of individuals to be measured are automatically calculated in the 'Schools of fish' section in the **DOVsProgressSheet** (Figure 25). You will need to enter the Family, Species and the total number of individuals making up the school. Measure the number of calculated in the spreadsheet in the column *Number of individuals to be measured* following the procedure described in the previous section 5.7.2 - Measuring individuals.

In some cases, you may not be able to measure the number of individuals recommended under our guidelines because there is too much overlap between fish or you are not able to determine the location of the same fish in both videos with a high level of confidence. Attempt to take measurements of fish as close as possible to the recommended amount. Keep track of the total number of individuals you actually measured and record this in the **DOVsProgressSheet** (Figure 25).

You can double check the total number of fish measured by using the *Data* window under the **3D Measurements** option from the dropdown list (Figure 28). You can sort data by species by clicking on the *Species* column and check at what period and time measurements were taken.

- Save your progress so far by clicking on *Measurement -> Save*.

Figure 27 – Top panel showing a school of *Lutjanus viridis*. Bottom panel showing a disperse group of *Johnrandallia nigrirostris*, which do not classify as a school as they do not form a cohesive group.

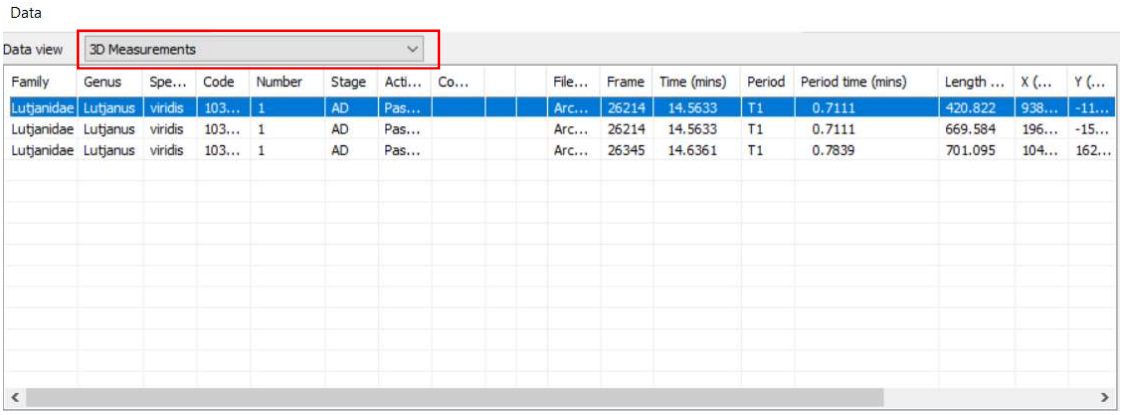


Figure 28 – *Data* window showing the **3D Measurements** option from the dropdown list (red box). This will bring up the total number of fish measured in the video.

5.9 Non-interest species – herbivorous fish

Once the species of interest have been identified, counted and measured, you can now move to processing non-interest species. For this project, herbivorous fish are considered as species of no-interest. A list of the Families included in this group can be found in the *spp* tab of the **DOVsProgressSheet** (Figure 23).

The process for non-interest species is similar to the species of interest, one person will identify and count individuals and a second person will measure and review identifications. You will also need to record your name in the column for *Species identification* or *Measurements taken* under the ***Spp no interest*** section of the **DOVsProgressSheet** when you complete these tasks.

Note that this will be second time you will review the second time that you will review the same DOV video.

5.9.1 Identifying and counting individuals of no interest

- Go to the beginning of transect 1, T1, by either double clicking it on the *Data* window (bottom panel Figure 22), or by jumping to the start time of T1 using the *Jump to frame* option (Figure 18).
- Identify ALL individuals belonging to the families of no-interest (*spp* tab of the **DOVsProgressSheet,** Figure 23) you see in the video following the process described in Section 5.7.1 - Identifying and counting individuals of interest.
- If you encounter 20 or more individuals of the same species in the same vicinity forming a cohesive group (often moving in unison), we consider them to be a school (Figure 27). You will count all individuals in EM and record this information under the 'Schools of fish' section in the *progr1-Interest-School-Gring* tab in the **DOVsProgressSheet**. If you encounter more than one school in one transect, simply enter a second row with this information (Figure 25).
- Once you reach the end of the first period, write down your name in the *Species identification* column of the **DOVsProgressSheet** (*Spp no interest* section).
- Save your progress so far by clicking on *Measurement -> Save*.
- Fast forward to T2 and repeat the process above until you reach T8. Ensure you record your name in the **DOVsProgressSheet** every time you finish analysing a transect.

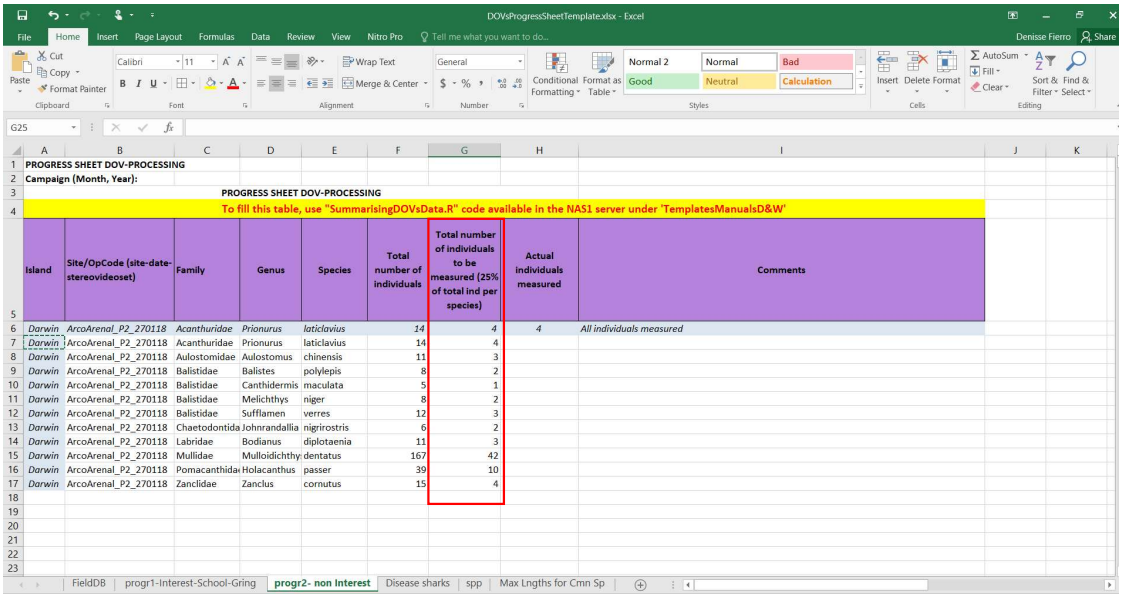
Note: Only individuals that meet the following requirements can be included in the counts:

- Individuals must be at least 8 cm long. If unsure you can measure the individual in question, but do NOT save the measurement.
- The same individual MUST appear in both cameras (left and right).
- The individual MUST appear for the first time within the period (e.g., T1 to T8). If the individual appears between periods (15 second gap), it cannot be included.

5.9.2 Measuring individuals of no interest

Load videos, calibration files, species list and edit information fields following the instructions given in previous section of this protocol. Although if you load the EMObs file containing the identification and counts of fish you may not have to do this again. Ensure videos are synchronised correctly and that you have locked both videos to keep synchronisation throughout the duration of the video. Once this has been done, you are ready to start measuring individuals.

- Open the *progr2- non Interest* tab in the **DOVsProgressSheet** (Figure 29). You will need to fill in this tab before you measure any fish.



PROGRESS SHEET DOV-PROCESSING

Campaign (Month, Year):

PROGRESS SHEET DOV-PROCESSING

To fill this table, use "SummarisingDOVsData.R" code available in the NAS1 server under 'TemplatesManualsD&W'

Island	Site/OpCode (site-date-stereovideoset)	Family	Genus	Species	Total number of individuals	Total number of individuals to be measured (25% of total ind per species)	Actual individuals measured	Comments
Darwin	ArcoArenal_P2_270118	Acanthuridae	Prionurus	laticlavius	14	4	4	All individuals measured
Darwin	ArcoArenal_P2_270118	Acanthuridae	Prionurus	laticlavius	14	4		
Darwin	ArcoArenal_P2_270118	Aulostomidae	Aulostomus	chinensis	11	3		
Darwin	ArcoArenal_P2_270118	Balistidae	Balistes	polylepis	8	2		
Darwin	ArcoArenal_P2_270118	Balistidae	Canthidermis	maculata	5	1		
Darwin	ArcoArenal_P2_270118	Balistidae	Melichthys	niger	8	2		
Darwin	ArcoArenal_P2_270118	Balistidae	Sufflamen	verres	12	3		
Darwin	ArcoArenal_P2_270118	Chaetodontida	Johnrandallia	nigrirostris	6	2		
Darwin	ArcoArenal_P2_270118	Labridae	Bodianus	diplotaenia	11	3		
Darwin	ArcoArenal_P2_270118	Mullidae	Mulloidichthy	dentatus	167	42		
Darwin	ArcoArenal_P2_270118	Pomacanthidae	Holacanthus	passer	39	10		
Darwin	ArcoArenal_P2_270118	Zanclidae	Zanclus	cornutus	15	4		

Figure 29 – Screenshot of the *progr2 – non Interest* tab of the **DOVsProgressSheet** with the outputs produced by the *SummarisingDOVsData* R script. The column in the red box indicates the total number of individuals that you need to measure for the entire video.

- In EM, you will need to produce a batch file, which is a text file containing information about all the individuals identified in the video so far. To do this, click on *Program -> Batch text file output* (Figure 30). Save your work if you are prompted to do so.
- A *Text report generation settings* window will appear (Figure 30). Here you will need to change the first three rows:
    - *Input file directory*, which is the directory where the EMObs file for your current project is located.
    - *Output file directory*, which is the directory where you would like the output batch file to be saved.
    - *Point measurements*, should be changed to **True**.
- Once all settings are changed, press the *Process* button. A *Text report generation summary* window will appear stating the name of the EMObs file used to produce the batch file. Click *Cancel*.

- Check the output folder and you will find the batch file (text file), which will be named the same as the input EMObs file followed by *_Dot Point Measurements*. For example, **ArcoArenal_20180120_B2_Dot Point Measurements.txt**

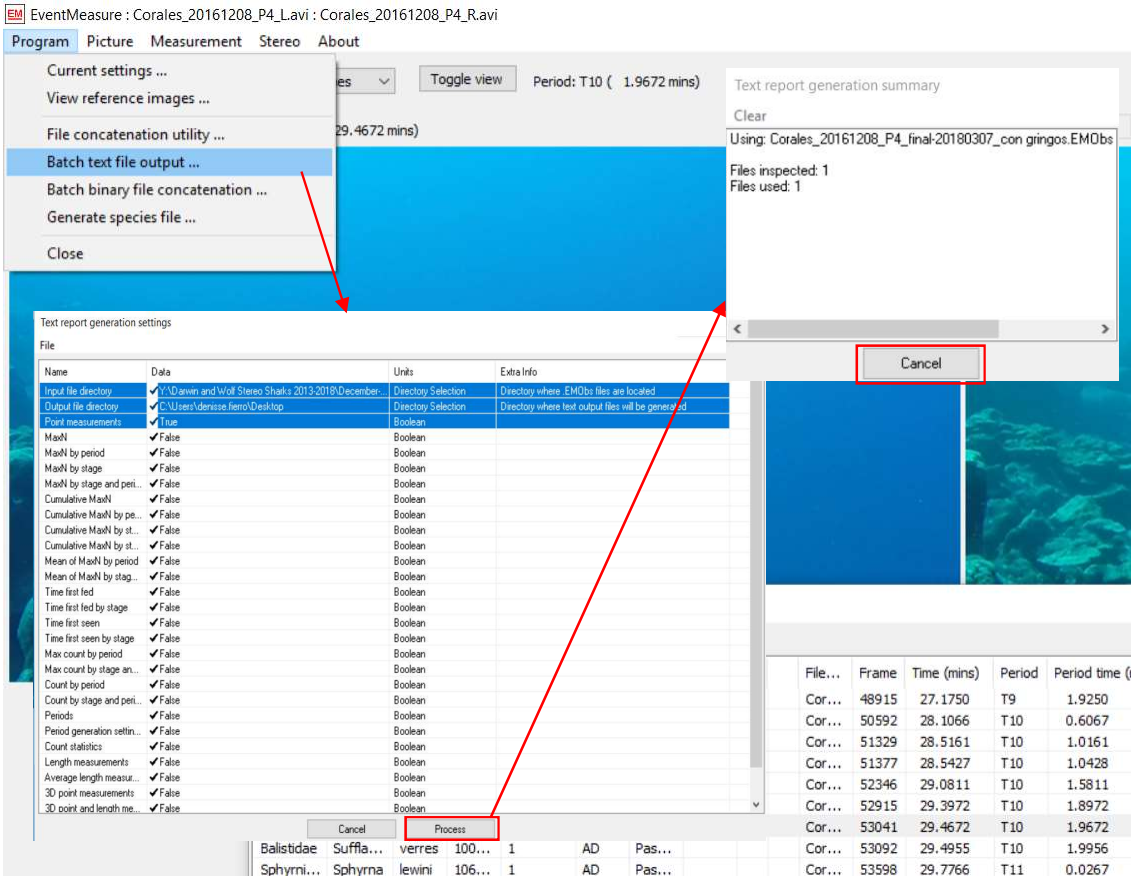


Figure 30 – Sequence describing how to create batch files for all transects contained within a video. The rows highlighted in blue in the *Text report generation settings* window must be updated in order to produce the batch file. Note that the *Point measurements* row must be set to **True**.

- Use the *SummarisingDOVsData.R* script (Figure 31) saved at \\NAS1:\Common Resources\Projects\SHARK SURVEYS\DOVS to calculate the number of individuals of no interest that must be measured for the entire video. Only change the directory of the input and output files required in the script (red box in Figure 31). When the script finishes running, check the output and copy it into the *progr2- non Interest* tab in the **DOVsProgressSheet** (Figure 29).
- In EM, using the *Data* window, select *Points* from the dropdown list. This will show you all the individuals identified in the video (Figure 26). Click on the column label, *Species*, to sort points alphabetically by species. Double click a row and this will fast forward the video to the frame that particular individual was identified in.
- You only need to measure the individuals calculated by the script (red box in Figure 29) following the steps described in Section 5.7.2 - Measuring individuals of interest.
- When you are done measuring individuals of one non-interest species, remember to include the number of individuals you actually measured in the *progr2- non Interest* tab in the **DOVsProgressSheet** (Figure 29).
- Save your progress so far by clicking on *Measurement -> Save*.

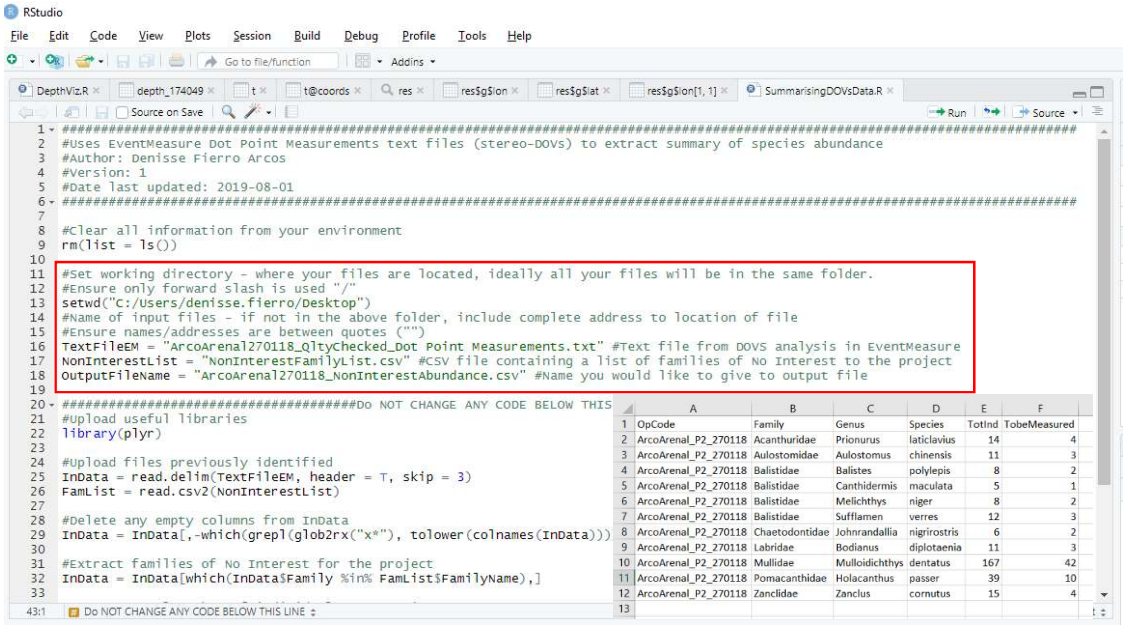


Figure 31 – Screenshot of the *SummarisingDOVsData* R script. You will only need to update the location of the input files (red box). The spreadsheet inset shows the structure of the output csv file produced by this script.

5.10 Gringos (*Paranthias colonus*)

As you may have noticed by now, Gringos (aka. *Paranthias colonus*) are by far the most common species of fish at Darwin and Wolf islands. Due to their extremely high abundances, often in the range of hundreds, we treat this species differently than the species of interest and species of no interest.

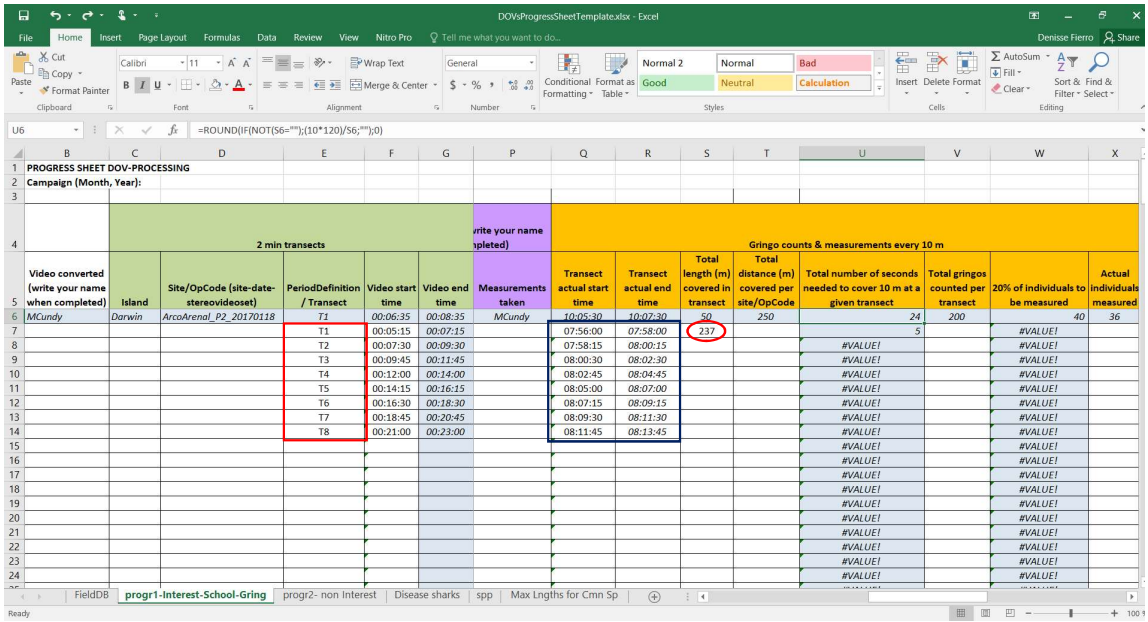
In the case of Gringos, we do not work with videos as such, but rather still frames from the video. We count **all** Gringos that appear within one frame every 10 m, this is mainly to avoid double counting individuals as it is easy to lose track of the animals you have previously counted.

Because we have GPS data from the buoy being towed on the surface, we can calculate how long it takes for a diver to cover 10 m. This calculation is done automatically in the *Gringos counts and measurements* section of the **DOVsProgressSheet** once you input the distance covered by the diver in each 2 meter transect. You will use the Garmin software, **Basecamp** to measure the length of each 2 meter transect as explained in the following section.

5.10.1 Downloading GPS data and calculating distance in Basecamp

It is recommended GPS data to be downloaded daily into your computer after data collection has been completed for the day. Remember to have a secondary back up copy to avoid data loss in case the first copy becomes corrupted or is lost.

- In the *Gringos counts and measurements* section of the *progr1-Interest-School-Gring* tab of the **DOVsProgressSheet** record the actual time the DOV transect started (Transect actual start time). Ensure you have written down T1 to T8 in the *Period Definition / Transect* (Figure 32) so the start and end times for each transect are automatically calculated.
- Open **Basecamp** in your computer.
- Connect the GPS device to your computer using the USB cable. Wait a couple of minutes until **Basecamp** recognises the GPS device.



	B	C	D	E	F	G	P	Q	R	S	T	U	V	W	X
1	PROGRESS SHEET DOV-PROCESSING														
2	Campaign (Month, Year):														
3															
4		2 min transects					rite your name npleted)	Gringo counts & measurements every 10 m							
5	Video converted (write your name when completed)	Island	Site/OpCode (site-date-stereovideoset)	PeriodDefinition / Transect	Video start time	Video end time	Measurements taken	Transect actual start time	Transect actual end time	Total length (m) covered in transect	Total distance (m) covered per site/OpCode	Total number of seconds needed to cover 10 m at a given transect	Total gringos counted per transect	20% of individuals to be measured	Actual individuals measured
6	*MCundy*	*Darwin*	*ArcoArenal_P2_20170118*	*T1*	*00:06:35*	*00:08:35*	*MCundy*	*10:05:30*	*10:07:30*	*50*	*250*	*24*	*200*	*40*	*36*
7				T1	00:05:15	*00:07:15*		07:56:00	*07:58:00*	*237*		5		#VALUE!	
8				T2	00:07:30	*00:09:30*		07:58:15	*08:00:15*			#VALUE!		#VALUE!	
9				T3	00:09:45	*00:11:45*		08:00:30	*08:02:30*			#VALUE!		#VALUE!	
10				T4	00:12:00	*00:14:00*		08:02:45	*08:04:45*			#VALUE!		#VALUE!	
11				T5	00:14:15	*00:16:15*		08:05:00	*08:07:00*			#VALUE!		#VALUE!	
12				T6	00:16:30	*00:18:30*		08:07:15	*08:09:15*			#VALUE!		#VALUE!	
13				T7	00:18:45	*00:20:45*		08:09:30	*08:11:30*			#VALUE!		#VALUE!	
14				T8	00:21:00	*00:23:00*		08:11:45	*08:13:45*			#VALUE!		#VALUE!	
15												#VALUE!		#VALUE!	
16												#VALUE!		#VALUE!	
17												#VALUE!		#VALUE!	
18												#VALUE!		#VALUE!	
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21												#VALUE!		#VALUE!	
22												#VALUE!		#VALUE!	
23												#VALUE!		#VALUE!	
24												#VALUE!		#VALUE!	

Figure 32 – Screenshot of the progr1-Interest-School-Gring *tab of the **DOVsProgressSheet***. Notice that you will need to write down the periods from T1 to T8 in the *PeriodDefinition/Transect* column (red box) before writing down the actual start of transect (first cell in blue box). This will calculate the start and end times for all transects automatically. The red circle indicates the cell where you need to input the length of the 2 minute transect.

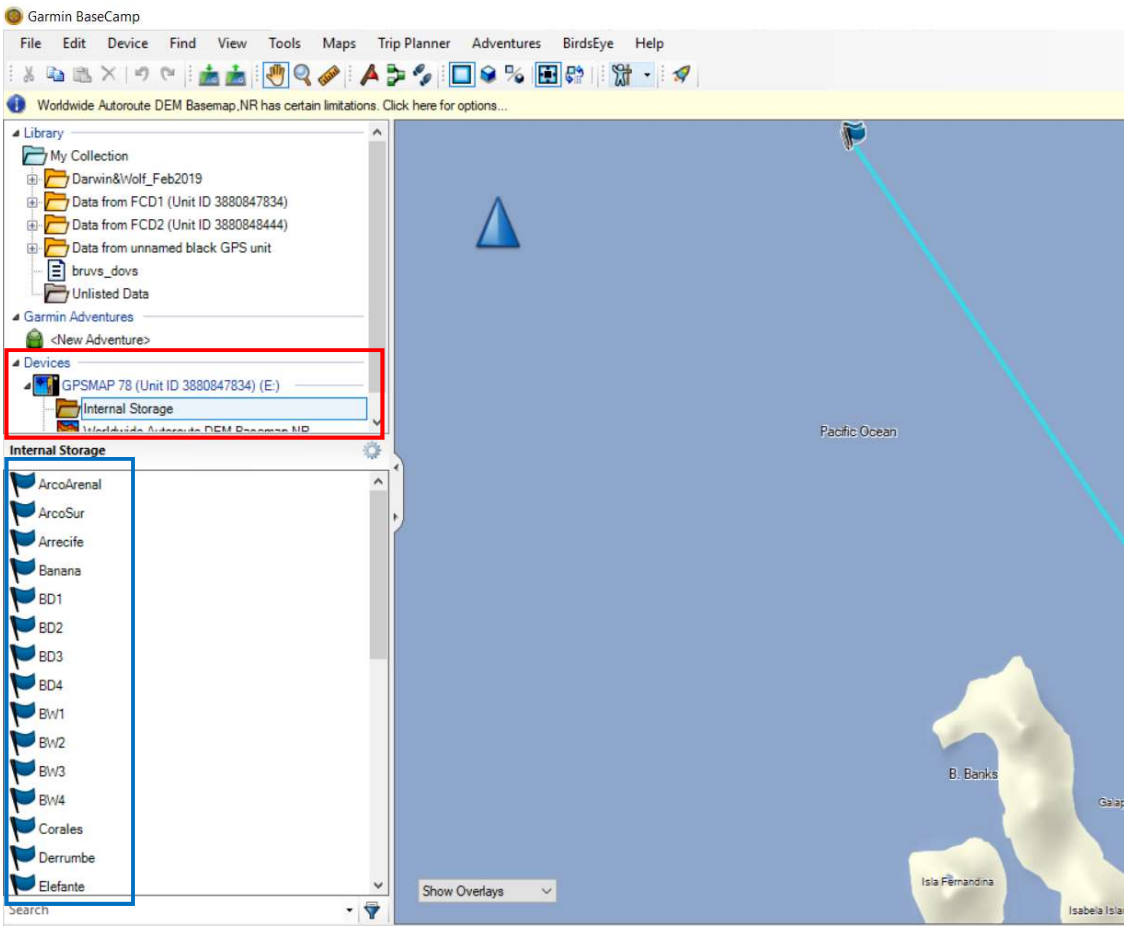


Figure 33 – Basecamp screen showing the GPS unit (red box) and the spatial data (i.e., tracks, waypoints) contained within its internal storage (blue box).

- Once recognised, the GPS will appear under *Devices* in the top left hand panel (red box in Figure 33). The name of the device will be the model of the GPS unit, followed by its Unit ID and the volume allocated to it, for example: **GPSMAP 78 (Unit ID 388047834) (E:)**.
- Right-click on the *My Collection* folder in the top left panel, and click on *New List Folder*. A new folder will appear under *My Collection*, rename it with the place the campaign took place, followed by the month (three initial letters of the month in English) and year (4 digits) it took place. For example, **Darwin&Wolf_Feb2019**. All tracks and waypoints related to a campaign will be saved under this folder.
- Click on the *Internal Storage* folder under the GPS unit to show the waypoints (marked with blue flags next to the waypoint name) and tracks (marked with two shoe prints next to the track name).
- Find the track for the day of collection you are interested in and right click it, then click on *Send To…* and a new window will pop up asking you to choose the destination folder. Find and click the folder you just created for this campaign and click *OK*. A new window will appear asking you to either select an existing list or to create a new one. Choose create a new list and name it using the date (international format), the GPS unit used and the name of the site, for example, **20190203_GPS2_Banana**. If more than one site were sampled on the same day, simply add a dash at the end and the name of the site, for example **20190203_GPS2_Banana-SharkWay-WolfNorte** (Figure 34).
- If everything was done correctly, then the *Library* panel on the top left side of your screen will have one folder for the campaign (e.g., **Darwin&Wolf_Feb2019**), which will contain a number of lists containing waypoints and tracks associated to sites sampled during that campaign (e.g., **20190203_GPS2_Banana-SharkWay-WolfNorte**) as show in Figure 35.
- To find the distance cover per transect, go to the list containing the site you are interested in and select it by clicking on it. This will show you the tracks and waypoints stored under that list on the bottom left panel (Figure 35).
- Double click on the track and this will open the *Track actual* window, which contains all the points recorded by the GPS unit during that particular track (Figure 35).
- Go to the *progr1-Interest-School-Gring* tab of the **DOVsProgressSheet** and if the actual start and end times of the transect you are processing (Figure 32). Go back to **Basecamp**, find the start time in the *Track actual* window and click on it. Now, while pressing the *Shift* key find the end time and click on it. This will highlight the 2 minute transect in blue (Figure 35), and the *Summary* box on the top left hand side of the window will show you the total number of points as well as the total distance covered in the highlighted transect.
  Note that the start time in the spreadsheet may not match exactly with the time shown in **Basecamp**. This is because the rate at which the GPS records data is not always constant, this means that sometimes you may get longer gaps between points. Simply try to match the actual start time with the closest point in **Basecamp**. For example, if the actual start time was 07:56:00, and basecamp has data points at 07:55:59 and 07:56:30, you will choose the first one (07:55:59) as this is closer to the actual time.
- Copy the total 2 minute transect length into the *Gringos counts and measurements* section of the *progr1-Interest-School-Gring* tab of the **DOVsProgressSheet** (red circle in Figure 32). This will automatically calculate the time it took the diver to cover 10 meters during that specific transect.
- Repeat these steps to calculate the distance covered in each of the eight 2 minute transects sampled at the site under review.
- Save your progress in the **DOVsProgressSheet**.
- Ensure there is a second copy (i.e., backup copy) of the **DOVsProgressSheet** and the GPS data in an external hard drive. Update this backup copy at the end of every day as needed.

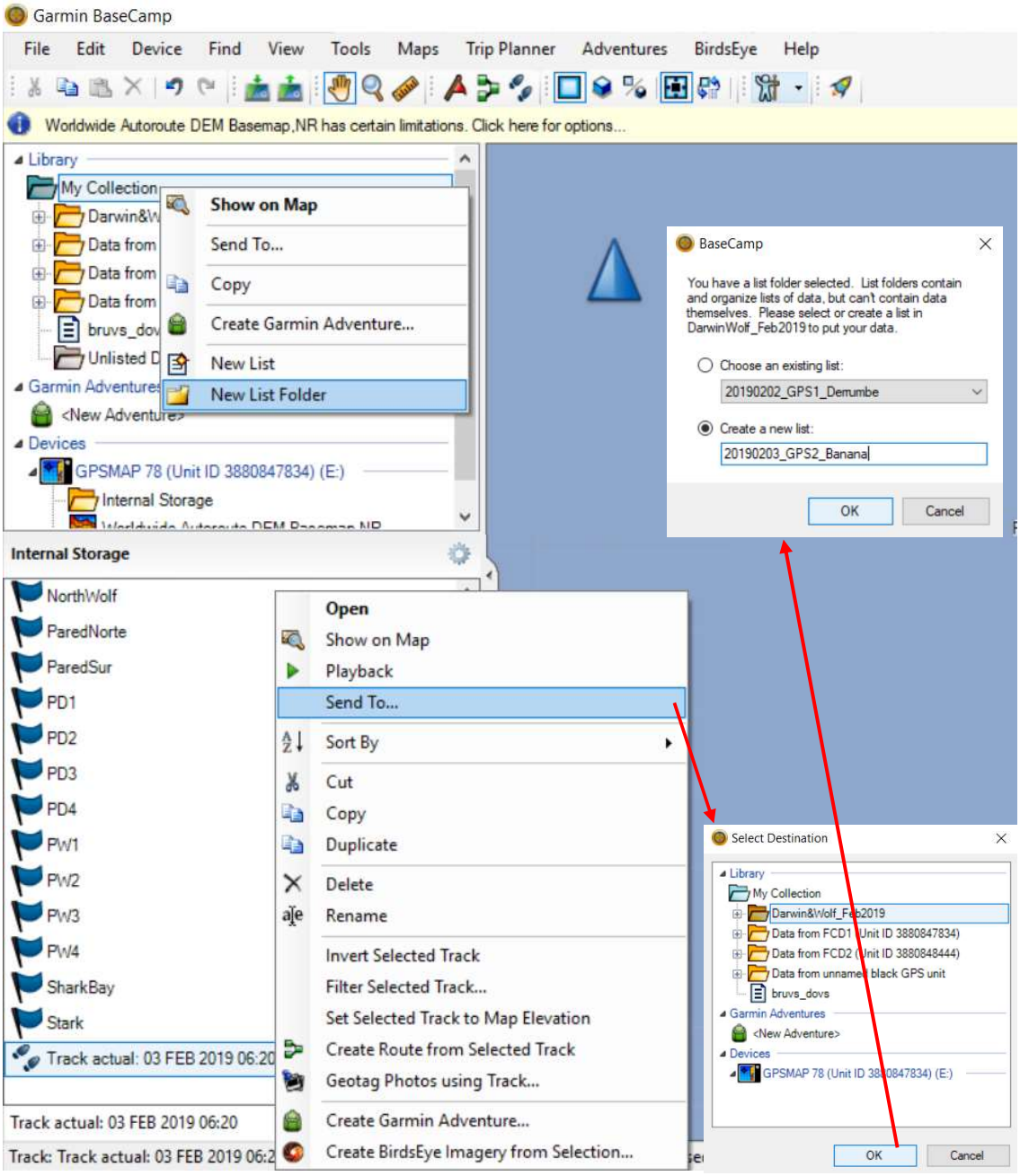


Figure 34 – Sequence showing creation of new folder for the new campaign being analysed, and saving spatial data in that newly folder.

5.10.2 Analysing Gringo data – Counting individuals

For this section you will need to refer to the *Gringos counts and measurements* section in the *progr1-Interest-School-Gring* tab of the **DOVsProgressSheet**. However, all the analysis will be done in EM.

- In EM use either the *Jump to Frame* option or the *Period definitions* option of the dropdown list in the *Data* window (Figure 22) to go to the beginning of the first transect/period (T1). Count all Gringos in this frame ONLY.

- Once you finish counting, fast forward the video by the number of seconds given in the *Total number of seconds needed to cover 10 m at a given transect* in the **DOVsProgressSheet** (Column U in Figure 32). Count all Gringos in that frame ONLY.
- Keep advancing the video by the number of seconds stated in the **DOVsProgressSheet** until you reach the end of transect 1.
- When you finish counting Gringos in T1, fast forward to the beginning of T2 and count all Gringos in that initial frame ONLY. Refer to the *Total number of seconds needed to cover 10 m at a given transect* for T2 in the **DOVsProgressSheet** (Column U in Figure 32) to find how many seconds you need to fast forward to continue counting Gringos.
- Repeat these steps until you reach the end of T8.
  Note that we calculate the time it takes the diver to cover 10 m for each transect in one site, so you may have eight different Gringo seconds.
- Save your progress so far by clicking on *Measurement -> Save*.

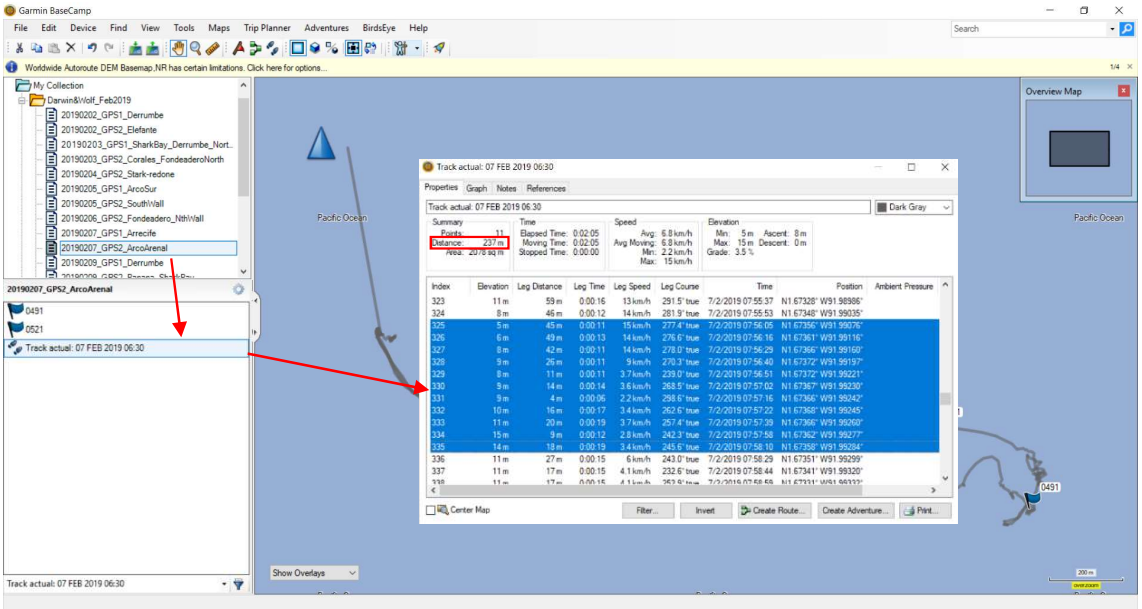
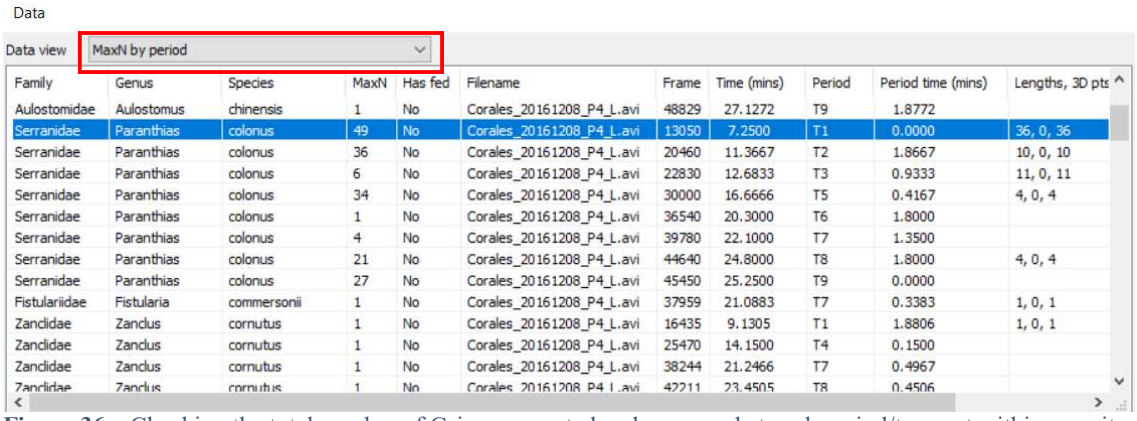


Figure 35 – Sequence showing how to measure the distance covered within a 2 minute period. The distance is meters is given in the top left corner (red square).

5.10.3 Analysing Gringo data – Measuring individuals

Due to the high numbers of Gringos that we often encounter in our videos, we only measure a subset of these animals. To be exact, we measure 20% of ALL Gringos measured within one site (i.e., eight 2 minute transects). You can measure these Gringos at any point during the video, if possible measure a range of sizes from small individuals to very large individuals to get a good estimate of the size ranges seen in Gringos at that site.

- Go to the *Data* window in EM and choose *MaxN by period* from the dropdown list (Figure 36). Sort data by species by clicking on the *Species* column name. Find the Gringos (*Paranthias colonus*) in the sorted list. You will have one row per period (T1 to T8) and the MaxN column will give you the total Gringos counted within that period.
- Write the MaxN per transect in the *Total gringos counted per transect* in the **DOVsProgressSheet** (purple box in Figure 37).
- Use the formula given on the column name to calculate 20% of Gringos to be measured for the entire site.



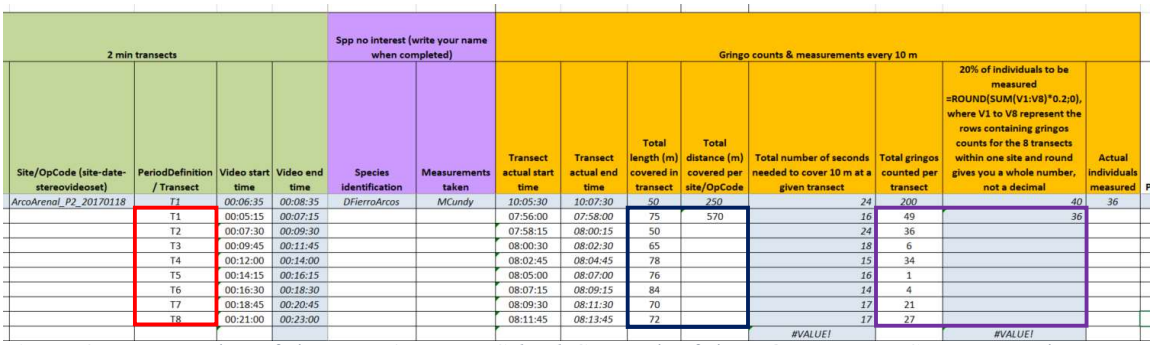
Data

Data view: MaxN by period

Family	Genus	Species	MaxN	Has fed	Filename	Frame	Time (mins)	Period	Period time (mins)	Lengths, 3D pts
Aulostomidae	Aulostomus	chinensis	1	No	Corales_20161208_P4_L.avi	48829	27.1272	T9	1.8772	
Serranidae	Paranthias	colonus	49	No	Corales_20161208_P4_L.avi	13050	7.2500	T1	0.0000	36, 0, 36
Serranidae	Paranthias	colonus	36	No	Corales_20161208_P4_L.avi	20460	11.3667	T2	1.8667	10, 0, 10
Serranidae	Paranthias	colonus	6	No	Corales_20161208_P4_L.avi	22830	12.6833	T3	0.9333	11, 0, 11
Serranidae	Paranthias	colonus	34	No	Corales_20161208_P4_L.avi	30000	16.6666	T5	0.4167	4, 0, 4
Serranidae	Paranthias	colonus	1	No	Corales_20161208_P4_L.avi	36540	20.3000	T6	1.8000	
Serranidae	Paranthias	colonus	4	No	Corales_20161208_P4_L.avi	39780	22.1000	T7	1.3500	
Serranidae	Paranthias	colonus	21	No	Corales_20161208_P4_L.avi	44640	24.8000	T8	1.8000	4, 0, 4
Serranidae	Paranthias	colonus	27	No	Corales_20161208_P4_L.avi	45450	25.2500	T9	0.0000	
Fistulariidae	Fistularia	commersonii	1	No	Corales_20161208_P4_L.avi	37959	21.0883	T7	0.3383	1, 0, 1
Zanclidae	Zanclus	cornutus	1	No	Corales_20161208_P4_L.avi	16435	9.1305	T1	1.8806	1, 0, 1
Zanclidae	Zanclus	cornutus	1	No	Corales_20161208_P4_L.avi	25470	14.1500	T4	0.1500	
Zanclidae	Zanclus	cornutus	1	No	Corales_20161208_P4_L.avi	38244	21.2466	T7	0.4967	
Zanclidae	Zanclus	cornutus	1	No	Corales_20161208_P4_L.avi	42211	23.4505	T8	0.4506	

Figure 36 – Checking the total number of Gringos counted and measured at each period/transect within one site suing the *MaxN by period* option from the dropdown list (red box) in the *Data* window in EventMeasure.

- In EM measure 20% of Gringos as calculated in the previous step. Remember that you can measure these individuals at any point during the video, regardless of the period you find them in.
- Once you finish measuring Gringos, go back to the *Data* window and choose *MaxN by period* from the dropdown list (Figure 36). Sort data by species and look for *P. colonus*. Check the *Lengths, 3D pts, total* column and pay attention to the first value (length). Add up all length values for Gringos and record this information in the *Actual individuals measured* column of the **DOVsProgressSheet**. You should have at least the same amount of measurements as the 20% gringo column (purple box in Figure 37).
- Save your progress by clicking on *Measurement -> Save*.



2 min transects				Spp no interest (write your name when completed)		Gringo counts & measurements every 10 m							
Site/OpCode (site-date-stereovideoset)	PeriodDefinition / Transect	Video start time	Video end time	Species identification	Measurements taken	Transect actual start time	Transect actual end time	Total length (m) covered in transect	Total distance (m) covered per site/OpCode	Total number of seconds needed to cover 10 m at a given transect	Total gringos counted per transect	20% of individuals to be measured =ROUND(SUM(V1:V8)*0.2;0), where V1 to V8 represent the rows containing gringos counts for the 8 transects within one site and round gives you a whole number, not a decimal	Actual individuals measured
ArcoArenal_P2_20170118	*T1*	*00:06:35*	*00:08:35*	*DFierroArcos*	*MCundy*	*10:05:30*	*10:07:30*	*50*	*250*	*24*	*200*	*40*	*36*
	T1	00:05:15	*00:07:15*			07:56:00	*07:58:00*	75	570	*16*	49	*36*	
	T2	00:07:30	*00:09:30*			07:58:15	*08:00:15*	50		*24*	36		
	T3	00:09:45	*00:11:45*			08:00:30	*08:02:30*	65		*18*	6		
	T4	00:12:00	*00:14:00*			08:02:45	*08:04:45*	78		*15*	34		
	T5	00:14:15	*00:16:15*			08:05:00	*08:07:00*	76		*16*	1		
	T6	00:16:30	*00:18:30*			08:07:15	*08:09:15*	84		*14*	4		
	T7	00:18:45	*00:20:45*			08:09:30	*08:11:30*	70		*17*	21		
	T8	00:21:00	*00:23:00*			08:11:45	*08:13:45*	72		*17*	27		
										#VALUE!		#VALUE!	

Figure 37 – Screenshot of the *progr1-Interest-School-Gring* tab of the **DOVsProgressSheet**. Note that some calculations are based on eight transects (red box). Total distance covered per site is a sum of the total transect distance (blue box). The percentage of gringos to be measured (purple box) is also calculated per site, rather than per transect.

5.11 Last steps - Checking your work

Before marking your job as done and passing it on to the second analyst for review, you will need to check your work to ensure any mistakes are corrected.

- Check all your identifications and counts are within the defined periods and not within the 15 second breaks. To do this you can use the *Points* option from the *Data* window. Ensure that each point has a period under the *Period* column. If there is blank in this column, you will need to reject this point. Before deleting it, go back to the point by double clicking it and check if you can see the same individual during a period. If you can see it, create a new point. If you cannot see it, then simply delete this point.

- Use the same window you opened in the previous step, to double check that all your identifications are correct. Remember, if you are unsure of an identification, make a note *Check ID* in the comments.
- If you took measurements of individuals, use the *3D Measurements* option in the dropdown list of the *Data* window. This will give you a summary of all measurements taken in the video. Check that all measurements meet the quality control criteria:
    - Precision value is < 10 % of the length measurement. For example, if Length = 882.119 mm and Precision = 11.224 mm, we see this condition has been met, as 10% of length is 88.2119 mm.
    - RMS values (both 1 and 2) are as close to 20 as possible, and always under 100.
    - If either Precision or RMS conditions are not met, reject the measurement and measure the individual again.
    - If both Precision and RMS conditions are met, accept the measurement.
- Save your progress once more by clicking on *Measurement -> Save*. Remember you will need to create a copy of your EMObs file in an external hard drive as back up at the end of your working day.
- Export a batch file for *Point measurements* and *3D point and length measurements* following the instructions described in Section 5.9.2 - Measuring individuals of no interest. The only difference is that you will also have to set to *3D point and length measurements* to True. You can find this option towards the end of the list in the *Text report generation settings* (Figure 30). These files should be saved in the *Batchfiles* folder under *DOVS* as explained in Section 2.1.2.1 - DOVS folder. This section will also explain the naming convention, which should be something like: **Banana_Jan2018_Counts.txt** and **Darwin_Jan2018_Measurements.txt**.

5.12 Quality control process

Quality control (QC) is a time consuming process that is of vital importance in ensuring the data collected is correct and consistent over time. QC must be completed by an experienced volunteer, with at least 6 months of experience, or a Supervisor. The QC process includes the following steps:

- Video analysts must be thoroughly trained by a senior team member in the correct use of EM and/or fish identification. After the initial training period, the new video analyst will have two (2) weeks to examine a 'testing video' on their own. This 'testing video' is any video that has been previously analysed and checked for accuracy by a senior member of our team. To be deemed competent, analysts must obtain a minimum of 90% accuracy in the identification of species present in the 'testing video'.
- Once the Analyst 1 has identified and counted individuals in a video, Analyst 2 will use the original EMObs file to measure all fish identified by Analyst 1. Analyst 2 must double check that IDs and counts by Analyst 1 are correct while completing measurements. Analyst 2 will pay special attention to any individuals marked as *Check ID*.
- Short footage, or still images if footage is unobtainable, must be shared with taxonomists when previously unrecorded (i.e., range or depth extensions), or unidentifiable species have been seen during the video analysis.

Ensure that any corrections are made to the EMObs files before any data is exported for further processing, or is made available in any repository.

5.13 Tips and shortcut keys in EM

- To zoom into an individual, locate the cursor over the fish you want to zoom in, hold the Ctrl key in your keyboard and move the cursor.
- If you have multiple individuals of the same species in the same frame, you can copy the last ID by selecting the it in the *Data* window. While selected, press Shift and right click over each individual of the same species.

Movie player

Key(s)	Action
Space bar	Play/pause playback
Left arrow	Step back 1 frame, puts movie in pause mode if playing
Ctrl + Left arrow	Step back 5 frames, puts movie in pause mode if playing
Shift + Left arrow	Step back 25 frames, puts movie in pause mode if playing
Right arrow	Step forward 1 frame, puts movie in pause mode if playing
Ctrl + Right arrow	Step forward 5 frames, puts movie in pause mode if playing
Shift + Right arrow	Step forward 25 frames, puts movie in pause mode if playing
Ctrl + mouse click on frame stepping controls	Step back/forward 5 frames, puts movie in pause mode if playing
Shift + mouse click on frame stepping controls	Step back/forward 25 frames, puts movie in pause mode if playing
Up arrow	Decrease playback rate
Down arrow	Increase playback rate
Escape	Close player, don't update movie position in main window
Enter	Close player, update movie position in main window

Data window

Key(s)	Action
w	Toggle input focus between main window and *Data* window
Enter	Drives main window image(s) to the currently selected item. Drive to period start for selected item in *Period definitions*.
Ctrl + Enter	Only for *Period definitions*, drives main window image(s) to the period end (if defined).
Up/down arrow	Change current data selection
Delete	Deletes current item (cannot delete in 'MaxN' type views)
h	Scrolls the list contents to make the currently selected item visible. Useful if you add a new measurement (added to the end of the list), but then want to scroll back to view the selected measurement.
e	Edit the selected measurement's attributes (also double right click). Only for *Points* or *3D measurements*. This does not drive to the measurement: press *Enter* then *e* to drive to the measurement and edit.

Main window

Key(s)	Action
w	Toggle input focus between main window and *Data* window
Space bar	Launch movie player (for the left movie in stereo mode)
Left arrow	Step back 1 frame (both movies in stereo mode)
Ctrl + Left arrow	Step back 5 frames (both movies in stereo mode)
Shift + Left arrow	Step back 25 frames (both movies in stereo mode)
Right arrow	Step forward 1 frame (both movies in stereo mode)
Ctrl + Right arrow	Step forward 5 frames (both movies in stereo mode)
Shift + Right arrow	Step forward 25 frames (both movies in stereo mode)
Ctrl + mouse click on frame stepping controls	Step back/forward 5 frames
Shift + mouse click on frame stepping controls	Step back/forward 25 frames
q	Hold down and drag image with left mouse button to pan (must be zoomed in, main window must have input focus)
a	Hold down and drag image with left mouse button to pan both left and right images (must be zoomed in, main window must have input focus, must be in stereo mode)
Shift + right mouse click (in left image for stereo)	Adds a point measurement copying attributes of the measurement currently selected in the *Data* window

6 Renewing EventMeasure licenses

SeaGIS licence keys expire yearly on February 1st, which means we need to arrange for their renewal by mid-January. We have two types of SeaGIS licences: USB keys and Software Keys. The instructions on how to renew them are described below.

6.1 USB keys

- Contact the software distributor advising them that SeaGIS licence is about to expire and needs renewing. Let them know how many USB licence keys need renewing. They should send back a V2C file attached to their reply, which will be used update the USB license keys. Download this file into a computer that has EM and CAL already installed.
- Once the file is saved in the computer you will use to update the licence keys, insert the USB license key.
- Open a *Windows file explorer* window. This is the window you usually use to find files in your computer. You can open a new window by right clicking the *Start* button and clicking on *File Explorer*.
- In this window, you need to navigate to the **SeaGIS** folder in your Program Files (e.g., *C:\Program Files (x86)\SeaGIS*). Inside this directory, you will find one folder for every

SeaGIS program installed in your computer (e.g., CAL and EventMeasure). You will need to update the licence for each one of them.

- Inside the package folder, open the **Executables** folder, find the file *hasprus.exe*, and double click on it to open the program. Example directory: *C:\Program Files (x86)\SeaGIS\CAL\Executables*
- When Hasprus open, select the *Apply License Update* tab and locate the V2C file that you previously saved in the computer by clicking the ellipsis (...) button. Click the *Apply Update* button and you will be asked to save a file, this is not necessary, so click *Cancel*.
- Open the SeaGIS software package that you just updated the licence for, and check the license has been updated. This will usually mean that you are now able to open the program.
- Once you have verified the licence is updated, you will need to do the same for every SeaGIS program installed in your computer.

6.2 Software keys

- Contact the software distributor advising them that SeaGIS licence is about to expire and needs renewing. Let them know how many software licence keys need renewing. They should reply to you with two keys and an options code. The should look something similar to the ones below:
  - Key 1: 06586CA904BB580714553C0
  - Key 2: F98FC64D44F6BD0728A04E5F0B8EA0
  - Options: 041C08043288041820041B58
- In the computer using the Software Licence Key, open EM. A window with an *Error with the license* message will pop-up and it will ask you for a new key. Click *Yes*, enter Key 1 when prompted and click *Ok*. You will be prompted to enter Key 2 and once you enter it, EM will open.
- Once the program has finished loading, select *Options* in the main menu and enter the Options code.

7 General troubleshooting in EM

7.1 One video is shorter than the other

The analysis of the video will vary slightly based on which video is shorter, the left or the right. In either case, you will set up the videos as per usual and start your analysis as described in this document.

- If the right video is shorter than the left. You will identify and count all individuals in your field of view using the left video for all transects. However, you will only be able to take measurements of individuals while you have footage on both the right and left.
- If the left video is shorter than the right, you will identify and count all individuals using the left video until you reach the end of it. Once you reach the end, load the right video on the left panel and create a new period named *Right video only* to mark the point at which videos were swapped. Continue identifying and counting individuals in your field of view until you reach the last transect on the right video. **Remember**, you will only be able to take measurements when you have footages for the left and right cameras.
- In both cases, make sure only one EMObs file exists.

7.2 Videos could not be converted and they are in MP4 format, but EM cannot read them

EM is usually able to read AVI files, but some older versions are not able to read MP4 files without adjusting some settings. If you get an error message when uploading MP4 files into EM do the following:

- While pressing the *Ctrl* key, click on *Program -> Current settings*. This will open the *Movie settings* window (Figure 38).
- Look for the *Movie handler type* row and double click on its *Data* column (red box in Figure 38). Choose *Prefer Media Foundation* from the dropdown list and click *OK*.
- Now find the *Movie player type* row and double click on its *Data* column (red box in Figure 38). Choose *Media Foundation* from the dropdown list and click *OK*.
- Click *Close dialog*.
- Now you can upload the MP4 files and they should be recognised by EM.

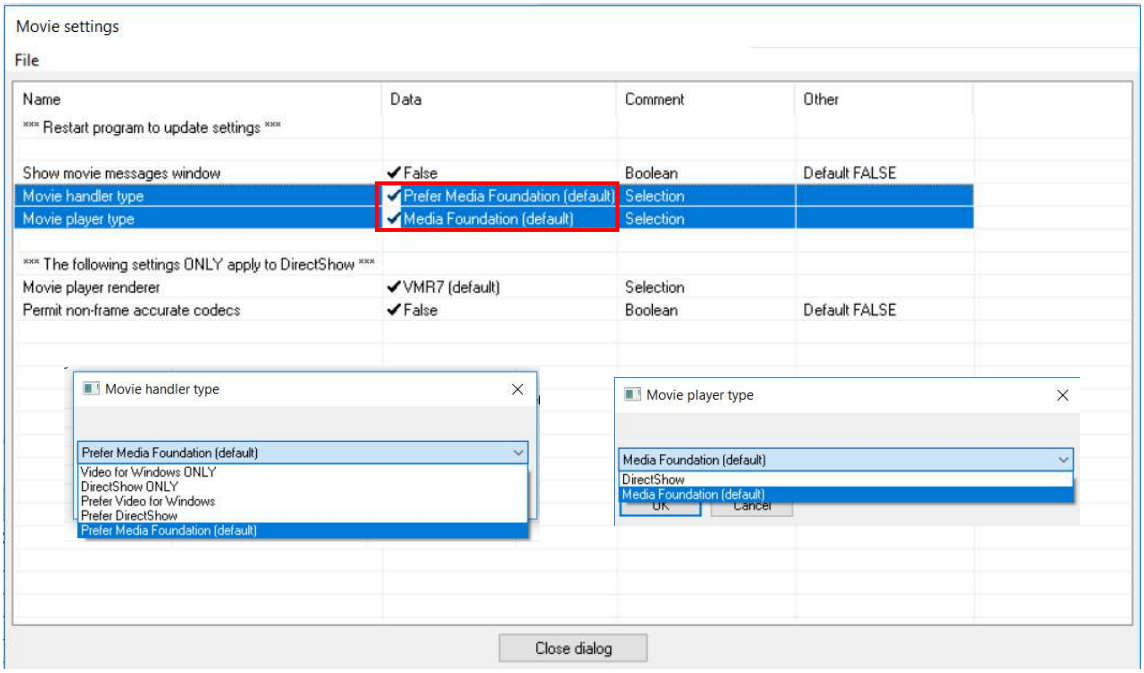


Figure 38 – Changing movie settings to allow EventMeasure to read MP4 files. Double clicking on the *Data* column of the *Movie handler type* row (red box) will open the options EM has to read video files.

7.3 An EMObs file is opened in EM, but when attempting to review a point in the *Data* window an error window appears

There are two possible causes for this error:

1. You have not set the picture directory and EM is unable to open the videos associated with that EMObs file. Simply set the directory by clicking on *Picture -> Set picture directory*.
2. You are using an old version of EM that cannot read a newer EMObs version. To fix this error you will need to install a newest version of EM available. If you are unable to do this, ask your Supervisor for help.

7.4 EM is not recognizing the license key

There could be various reasons causing this error:

1. The license key is not placed correctly in your USB port. Often the license keys work better if they are connected directly to your computer instead of to a USB multiplier. Try unplugging the USB and connect it again. If the same port fails twice, try a different port.
2. If no USB ports in your computer are able to recognise the license key, it may mean that the license key is broken. Advise your Supervisor of this problem.
3. The license key may have expired. Advise your Supervisor for assistance.

8 Maintenance of gear used in stereo-video sampling

Gear should be checked before fieldwork and after a campaign is completed, it is extremely important to clean all gear before storing it. Ideally, the gear should also undergo some basic maintenance about once a month to keep it in good shape.

8.1 Materials needed for maintenance

- Vinegar
- Drinking water
- Pipettes
- Small tray or container to soak screws
- Paper towels
- Tea towels/microfiber towels
- Vaseline
- O-ring grease
- 2 plastic bottles (small with wide opening to hold vinegar and water)
- 2 buckets
- Car battery (plus wood bottom and red trolley)
- SCUBA gear grease

8.2 GoBenthic housings maintenance

The GoBenthic camera housings (black frame) have screws to hold the housings into place. They must be cleaned before and after every field trip, and if possible once a month.

1. Pour drinking water and vinegar in the plastic bottles (one for each liquid), and tear up some paper towels so they are ready to use.
2. If needed, unscrew the front part of the housing. Make sure you use a star pattern, do not unscrew (or screw) two points from the same side. **Remember**, screws are particular to each hole, so make note of where you took them out. Do NOT mix them up.
3. Soak the screws in vinegar using a tray or container.
4. Clean each screw hole with the vinegar using a pipette. If salt is inside the holes, use the pipette to scratch it off the inside. Do NOT attempt to use any metal instruments to do this as you may damage the thread.
5. Once you are done, flush drink water using the pipette. Dry up the screw hole and ensure it is clean before moving onto the next.

6. Take the screws out of the vinegar and dry them up with the paper towels. Ensure you remove all dirt or grease from the thread.
7. Once cleaned, soak screws in drinking water for a few minutes.
8. Remove the O-ring on the front of the housing. Clean it with the microfiber towel, apply a small layer of grease, and place it back in the housing.
9. Dry the screws and cover them with a thin layer of Vaseline.
10. Screw the housing back into place. Remember to use a star pattern when screwing the housing. Do NOT screw two points on the same side.

8.3 SeaGIS housing maintenance

1. Wet some paper towels with vinegar and use them to clean the entire frame. Pay particular attention to the smaller bits and corners.
2. Clean the inside of the housings, including any holes.
3. Once cleaned, rinse the frames with drinking water.
4. Dry the frame using tea towels.

8.4 Metal tools

1. Prepare two buckets with a solution of 3 parts vinegar to 1 part drinking water.
2. Soak all tools in vinegar for 2-3 days to remove all rust. If any tools are excessively rusty, use a brush to scratch off the rust before leaving it to soak.
3. Take all tools out of the vinegar and soak in freshwater for a couple of hours.
4. Take tool out of the water to clean and dry them using paper towels.
5. Any tools that have moving parts will need some oil (WD40) or grease. Apply as necessary and remove excess with paper towels.
6. Let tools dry in a clean and dry place for about 3 hours.
7. Once tools are dry, put store them in their place.

8.5 Car battery and winch connections

The car battery is used to power the winch to pull up stereo-video sets out of the water while in the field. The battery is always stored over a wooden base to avoid it from draining energy. It is important that it is NOT kept directly on the floor.

About two weeks before a campaign, contact the Maintenance department to get the battery checked and recharged. You will also need to check the connections from the winch to the battery and replace them if necessary. Ask Maintenance for assistance if needed.

8.6 SCUBA gear

- All BCDs have to be washed inside and out with freshwater. They must be thoroughly dried before they are put away. Ensure any water is removed from the inside.
- Grab the regulators with the computers. Add a few drops of vinegar to the dive computer to remove any salt from the buttons. Rinse everything with freshwater and leave to dry. Store equipment on a flat surface. Do NOT hang them as this may damage the hoses.
- Before storing any equipment, spray some lubricant on the computer buttons, any metal parts at the start and end of each hose and the BCD inflator, as well as inside the regulators and octopus.